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* General studies, see also individual crops.

Plant Breeding Abstracts.

Vol. IV, No. I.

Part I. British Empire

GENETICS 575

1. NAVASHIN, M. and SHKVARNIKOV, P. 575.24:581.036
Process of mutation in resting seeds accelerated by increased temperature.
Nature 1933 : 132 : 482–83.

As a further test of the hypothesis of the metabolic origin of mutation (See " Plant Breeding Abstracts," Vol. III, Abst. 552), seeds of *Crepis tectorum* L. were subjected to a temperature of 54°—55° C. for varying periods. Many of the surviving plants displayed various developmental anomalies and cytological examination disclosed numerous chromosome translocations, the mutants being chimaeras.

The effect of heat between 50°C. and 60°C. acting for 20 days was found comparable to the effect of aging at room temperature for 6-7 years.

Heat acting on " resting " seeds must therefore be an important factor in increasing the mutation rate in nature and under agricultural conditions.

EVOLUTION 576.12

2. HURST, C. C. 576.12
Progressive evolution.
Emp. Cott. Grow. Rev. 1933 : 10 : 195–205.

In tracing the causes of evolutionary progress the author first states succinctly the known facts about the genes and chromosomes and the interactions of the gene complex. The development from the progene or autocatalytic molecule (which may perhaps represent the transitional state between life and matter) to the few genes present in the bacteria and then through simple gene complexes to the elaborate chromosome organization of the higher forms finds its parallel in the ever increasing complexity and variety of form and structure found in the scale of organisms ranging from the lowest to the highest plant forms. Gradually too with the evolution of higher types sex was evolved, primitive at first, but becoming increasingly better adapted and also more valuable as a source of variation by the segregation and recombination of characters.

The most potent influence in progressive evolution must be attributed to gene changes occurring as mutations and chromosome transmutations of various kinds, for from such irregularities permanent forms such as species and genera may arise. And here the duplication of entire chromosome sets is of primary importance offering as it does the possibility of obtaining valuable new species by hybridization of two useful species differing in their desirable characteristics.

Among all these changes which take place continuously, though rarely, from age to age certain isolated advantageous variations must arise and upon these progressive evolution is based.

CYTOLOGY 576.3

576.353
3. HUSKINS, C. L. 576.354.4
Mitosis and meiosis.
Nature 1933 : 132 : 62–63.

From observations on certain cereals, grasses and grasshoppers the author claims to shew that at all stages of mitosis and meiosis chromosome threads are attracted in pairs and pairs of pairs are repulsed, and on this basis a unified theory of chromosome behaviour for mitosis and meiosis can be built up. Up to the diplotene stage the above observations agree in general with Darlington's theory, but a tertiary split, which has its counterpart in a split that occurs at a parallel stage of mitosis takes place before meiotic metaphase and sets up repulsion within the 4-partite chromosomes and causes their arms to separate widely at anaphase, thus preparing them for the second meiotic division in which the pre-metaphase split is omitted as a mechanical consequence of these preceding stages.

4. JACKSON, F. K. and WAD, Y. D. 631.421
The design and conduct of field experiments.
Agric. and Live-st. Ind. 1933 : 3 : 211–33.

A beginning has been made at Indore with placing the agricultural experimental work on a sound basis and instituting a large number of trials capable of accurate statistical analysis. A description is given of the nature of the tests being carried out, and of the numerous practical details to be attended to. Schemes are appended for standardizing the reporting and statistical working of the results.

5. MAHALANOBIS, P. C.; MAHALANOBIS, P. C. and BOSE, S. S. 631.421:519.24
Statistical notes for agricultural workers.
No. 5. A note on the variation of percentage infection of wilt disease in cotton. Ind. J. Agric. Sci. 1932 : 2 : 704–709.
No. 6. The effect of fertilizers on the variability of the yield and the rate of shedding of buds, flowers and bolls in the cotton plant in Surat. Ibid 1933 : 3 : 131–138.
No. 7. The effect of the time of application of fertilizers on the yield and the rate of shedding of buds, flowers and bolls in the cotton plant in Surat. Ibid 3 : 139–146.
No. 8. The effect of different doses of nitrogen on the rate of shedding of buds, flowers and bolls in the cotton plant in Surat. Ibid 3 : 147–154.
No. 9. Certain varietal studies on the cotton plant in Surat. Ibid 3 : 339–344.
No. 10. The analysis of a manurial experiment on wheat conducted at Sakrand, Sind. Ibid 3 : 345–348.
No. 11. The use of the method of paired differences for estimating the significance of field trials. Ibid 3 : 349–352.
No. 12. Analysis of varietal tests with wheat conducted at Sakrand, Sind, 1931-32. Ibid 3 : 544–548.
No. 13. On the need of randomization of plots in field trials. Ibid 3 : 549–551.

In continuation of the series of notes dealing mainly with statistical methods and procedure arising out of enquiries from agricultural workers in different parts of India, the authors deal with a number of experimental results received by them. Points of interest arise which should be useful to other workers in this sphere. The last note consists of a strong plea for the proper setting out of experiments so that valid deductions may be possible.

6. YATES, F. 631.421:519.24
The analysis of replicated experiments when the field results are incomplete.
Emp. J. Exptl. Agric., 1933 : 1 : 129–42.

A previous method for finding a single missing value in a randomized block or latin square experiment is here extended to deal generally with multiple classifications, and with any number of missing plot values. It is shown that when the results are worked out with the values so found the significance of treatment effects is always slightly exaggerated, a point not previously pointed out, unless special methods are taken to correct for this. The methods and formulae are illustrated by means of an example, and it is suggested that the method may be useful in testing interactions, even where no value is missing, by analysing the results with and without some value which appears to be of special significance.

CEREALS 633.1

7. GFELLER, F., DERRICK, R. A. and FRASER, J. G. C. 633.1:581.143.26.03
Yarovization or vernalization of cereal crops.
Sci. Agric. 1933 : 13 : 728–29.

Lyssenko's work on vernalization (see " Plant Breeding Abstracts," Vol. III, Abst. 554) has been confirmed by results obtained with spring and winter cereals under greenhouse conditions at the Central Experimental Farm, Ottawa. Field experiments are now in progress.

WHEAT 633.11

8. HILGENDORF, F. W. 633.11:575(93.1)
A promising crossbred wheat.
J. Canterbury (N.Z.) Agric. Ass. 1931 : 19 : p. 29.

Among the wheats taken over by the Wheat Research Institute, New Zealand from Lincoln College is a cross made in 1923 between Tuscan and White Fife. The lines from this cross have proved approximately equal to Tuscan in yield, similar in growth characters, and with a solid, short, strong, upright straw and tight, wind-resisting chaff. The grain is large and though thick-skinned, yielded 75 per cent of flour (and the 5 best lines even 77 per cent) as compared with 69 per cent obtained from Tuscan. In baking tests the loaves from " crossbred " flour gained 29 points (and even an average of 33 for the 5 best) as compared with the 24 points for Tuscan. Further trials are still required.

9. FRANKEL, O. H. 633.11:575.061.633
A case of mass-occurrence of non-inherited chlorophyll defects in wheats.
Trans. N.Z. Inst. 1933 : 63 : 142–43.

A number of plants with striped leaves ranging from white with a narrow green line to the reverse variegation occurred among a collection of foreign varieties of *T. vulgare*, *T. turgidum* and *T. durum*. No such appearance was noticed among the New Zealand wheats grown at the same time.

Seed from the variegated plant was sown the following year but no striping occurred among the progeny and no explanation is attempted.

10. WATERHOUSE, W. L. 633.11:575.127.2
On the production of fertile hybrids from crosses between *vulgare* and Khapli emmer wheats.
Proc. Linn. Soc. N.S.W. 1933 : 58 : 99–104.

Personal communications from the Economic Botanist of the Central Provinces, India, to the effect that certain *vulgare* wheats are derived from crosses of *vulgare* x Khapli are quoted. The Indian Khapli has proved to be a distinct subspecies from the American one but it also gives sterile F_1's with Federation.

A great number of other varieties of *vulgare* have been crossed with very varying results, extreme chlorosis being a common defect in nearly all the hybrids. Resistance to flag smut, and stem rust forms 43 and 46 was dominant, to form 34 recessive. Eighteen varieties gave fertile progeny, seven of these being derivatives of crosses involving *T. durum*, some of which however also gave sterile hybrids. Some crosses are now in the F_3 which shew great variation, *vulgare* types being few.

The parentage of those varieties which gave fertile hybrids was traced to the varieties Garra and Steinwedel, which were then used in crossing. By so doing a set of 65 per cent, equal to that obtained in intraspecies crosses, was obtained, the grain being plump and the hybrids very vigorous. Their disease reactions were nevertheless the same as in the earlier hybrids. These hybrids developed normal heads and were mainly intermediate in respect of parental characters. Self-pollination gave 1 per cent success, back-crosses and crosses with other *vulgare* varieties somewhat more, free pollination as much as 17.2 per cent.

Similar success has been obtained by crossing these wheats with other *durums* such as Gaza, Beladi and Iumillo.

The variety Garra also proves to be a derivative of Steinwedel.

11. GURNEY, H. C. 633.11:575.127.5:633.14:575.3
The cytology of wheat x rye hybrids of the 5th and 6th generation.
Aust. J. Exptl. Biol. Med. Sci. 1933 : **11** : 123–37.

The original cross was between the variety of *T. vulgare* known as Marshall's No. 3 and New Zealand rye. There was one F_1 plant resembling rye. Of the three F_2 plants only one, probably backcrossed with wheat, was fertile and gave rise to the F_3 and F_4 from which the data for the present paper were collected.

The general cytological observations were made on the intermediate types and shewed a single spireme with twisted loops at prophase, the univalents arising from the constricted ends. Metaphase was very irregular due to the erratic behaviour of some of the bivalents, to the number of univalents and to the presence of the tetravalents. Chromosomes characteristic of both wheat and rye could be distinguished. The haploid chromosome numbers of the normal plants varied from 15–21, a range definitely higher than that of the dwarf plant which was 13–18. The tall plants also shewed a greater number of univalents which were not lined up on the metaphase plate and a greater number of lagging chromosomes. The linking up of univalents in a chain appeared to be a characteristic of the dwarfs. The plants resembling rye had the same number of chromosomes as the intermediate forms but there was a definite preponderance of characteristic rye chromosomes.

The wheat-like type had a slightly higher and less variable number of chromosomes 20–22 and a preponderance of wheat chromosomes.

Contrary to expectation the hybrids are fairly fertile although complete sets of neither wheat nor rye chromosomes are present. Sterility and low chromosome number seem to be associated with dwarfness.

Many of the plants shewed varying degrees of spelting which is probably due to chromosome aberration.

12. PHIPPS, I. F. and GURNEY, H. C. 633.11:575.242:576.356.4
A preliminary note on the origin of a B-type speltoid in *Triticum vulgare*.
Aust. J. Exptl. Biol. Med. Sci. 1932 : **10** : 215–18.

In a cross between awned and awnless forms of *T. vulgare* one of the four F_1 plants obtained was a speltoid, having lax ear, stiff glumes and strong keel. It failed to segregate for awns and gave 44 speltoid : 6 normal, i.e. 7 : 1 as expected in a B type speltoid. The chromosome lost is evidently the one carrying the awns in the female parent. The loss must have been before the division of the zygote, since all ears of the F_1 plant were speltoid.

In the F_2 segregation for tip-awns versus awnless occurred independently of the speltoid character, the gene modifying the length of the tip-awn being evidently in a different chromosome.

Three weak, sterile plants with full awns occurred amongst 1,060 F_2 speltoids. These were assumed to be homozygous 40 chromosome speltoids, a second, independent gene for awns being operative, which is also suggested by other results of the authors on awn inheritance.

Of 15 plants obtained by crossing with an awned normal, 12 were awned and speltoid, the other three awnless and non-speltoid. This indicates that the speltoid was due to the lack of a chromosome, and that the homologue contained the gene for awnlessness. Root tip examinations also shewed 41 chromosomes and at meiosis 20 bivalents and 1 univalent were evident. The univalent frequently lagged and was sometimes excluded from the nucleus. Related non-speltoid plants had 21 bivalents.

13. BROADFOOT, W. C. and ROBERTSON, H. T. 633.11:581.46:575.061.6
Pseudo-black chaff of Reward wheat.
Sci. Agric. 1933 : **13** : 512–14.

An investigation of the causes of glumes discoloured by dark areas that occur in Reward wheat suggested that the condition might possibly be due to the expression under certain environmental conditions of some hereditary colour factor present in the Reward genotype. A histological examination of the glumes of normal and discoloured Reward and Marquis wheat and of the normal glumes of Kahla, together with cultural studies pointed to the possible existence in

certain strains of Reward wheat of some such colour factors which with suitable intensity of light result in the pigmented areas. If this finding is correct, many strains of Reward will continue to produce dark glumes, the intensity of the discolouration depending on certain environmental factors and principally light.

14. BRIGGS, F. N. 633.11–2.451.3–1.521.6:575.11
A third genetic factor for resistance to bunt, *Tilletia tritici*, in wheat hybrids.
J. Genet. 1933 : **27** : 435–41.

Crosses of White Federation with Turkey 1558 and Turkey 3055 have previously shewn that each of these differs from White Federation in one major factor (see " Plant Breeding Abstracts," Vol. II, Abst. 602).
The results resembled those from crosses involving the Hussar factor (see " Plant Breeding Abstracts," Vol. I, Abst. 57), dominance being incomplete.
F_2 ratios based on the behaviour of the F_3 rows to Reed's " physiologic race III " of the fungus are here described.
Crosses between the 2 Turkey lines gave no susceptible rows, shewing that the factor they contained was identical ; a slightly higher degree of infection suggests the operation of modifying factors.
Crosses of the Turkey lines with Selection 1403, containing the Hussar factor, gave typical 2-factor ratios, from which it is evident that the Turkey factor is distinct from the Hussar factor. Previous crosses have shewn it to be distinct from the Martin factor.
According to expectation the behaviour of the cross between Hussar (2 factors) and Turkey (1 factor) was typical of a cross involving 3 factors. A fourth factor is apparently present in Florence, whose resistance is reported as recessive (see " Plant Breeding Abstracts," Vol. III, Abst. 143).

15. SCOTT, R. C. 633.11–2.452–1.521.6
Rust in wheat crops in South Australia, season, 1932-33.
J. Dept. Agric. S. Aust. 1933 : **36** : 1144–47.

Having briefly outlined for the practical wheat breeder the salient points relating to rust infection, the prevalence of rust in 1932-33 is indicated and the reports received about the relative resistance of the more widely grown varieties are shortly summarized. Apparently Ford and Sword (both bred at Roseworthy Agricultural College) withstood red rust extremely well and yielded good quality grain. These two wheats are shewn to be closely related and have probably acquired their resistance from a common ancestor " Crossbred 53." They are recommended as " the most rust-resistant varieties in cultivation to-day."

16. NEATBY, K. W. 633.11–2.452–1.521.6:575
The type of infection of wheat seedlings by *Puccinia graminis tritici* in the greenhouse as a measure of the percentage infection in the field.
Sci. Agric. 1933 : **13** : 625–35.

In view of the conflicting results obtained in previous investigations on the relation between greenhouse and field reactions of wheat varieties and strains to *Puccinia graminis tritici* the problem was again attacked by a study of the behaviour of the crosses of Marquillo x Reward, Garnet x Marquillo, and Garnet x Double Cross to infection with form 21 of *P. graminis tritici* in the greenhouse and with about 30 physiological forms used in artificially induced epidemics in the field. Natural infection also occurred in the field.
In the Marquillo x Reward cross the relationship between the F_2 and F_3 field reactions was remarkably close so that the field classification of the F_2 must have been fairly accurate, and a comparison between the F_2 field reaction and the F_3 greenhouse reaction tended to shew that the inheritance of the field reaction in this cross is mainly, if not entirely, controlled by the factors governing the inheritance of the seedling reaction to form 21 in the greenhouse. If this is so the lines segregating for the reaction to form 21 in the greenhouse should also segregate in the field. The correlation between the standard errors for the two sets of reactions scarcely bore this

out, owing to the fact that lines homozygous for the field resistance of Marquillo displayed considerable variation. Closer examination of the data, however, shewed that the seedling reaction in the greenhouse of lines carrying Marquillo resistance is relatively constant ; the field reaction is subject to considerable variation. On the whole no lines were obtained with a high " field resistance " that were not also resistant as seedlings to form 21 ; and conversely all lines resistant to form 21 in the greenhouse were resistant under field conditions.
In Garnet x Marquillo though the various relationships were not so close the results tended to confirm the above conclusion regarding Marquillo resistance and to shew that numerous genetical factors are involved in this cross, since not one line bred true for the seedling reaction of Marquillo to form 21. Incidentally it is stated that the F_2 distribution of the field reaction for the cross Iumillo x Mindum is probably inherited in a relatively simple manner in this " intra-*durum* " cross. Marquillo inherits only a small degree of the resistance of Iumillo judging from both field and greenhouse reactions, yet the inheritance of Marquillo resistance in intra-*vulgare* crosses is very complicated. Details of this cross are to be published soon.
In the greenhouse study of Garnet x Double Cross (See " Plant Breeding Abstracts," Vol. II, Abst. 170) eleven physiological forms were used.
From this cross as well as the two Marquillo crosses discussed it is clear that under Winnipeg conditions inheritance of field resistance to stem rust is controlled mainly by the factors governing the inheritance of seedlings to certain physiological forms in the greenhouse and the seedling reaction to form 21 alone is a reliable test for selection for field resistance. Moreover in Garnet x Double Cross, lines carrying Kanred immunity to form 21 may or may not be resistant in the field, but lines with Marquillo resistance to form 21 will also be resistant to form 36 in the seedling stage and will possess in the field resistance similar to that of Marquillo.
Hence Marquillo and Double Cross do not appear to possess any mature plant resistance such as has been identified in H–44–24 and Pentad.

17. GRIFFITHS, E. ET AL 633.11:664.641.016
Experimental baking tests. Their value and interpretation.
Agric. Gaz. N.S.W. 1933 : 44 : 413–20.
An informative article which should interest the economic breeder to whom superior baking quality must be of considerable importance. The value of experimental baking tests as an aid in selection for valuable commercial types of wheat is emphasized.

18. SIM, J. T. R. and VORSTER, P. W. 633.11:664.641.016(68)
Experimental milling and baking tests on South African wheat varieties. A preliminary report.
Sci. Bull. Pretoria 1933 : No. 116 : Pp. 91.
The first part deals with the problem and methods of investigation of the improvement of wheat quality in South Africa.
Part II deals with the chemical, milling and baking properties of South African varieties of wheat during the season 1929. The environmental conditions under which the varieties tested were grown are treated in an appendix. A bibliography of 74 references is included.

19. SIM, J. T. R. and VORSTER, P. W. 633.11:664.641.016(68)
Experimental milling and baking tests on South African wheat varieties.
Fmg. S. Afr. 1933 : 8 : 301–02.
A short outline of the views and data contained in preceding Abstract.

OATS 633.13

20. 633.13 633.16
Guide to Boghall Experimental Farm.
Edinburgh and E. Scot. Coll. Agric. 1933 : Pp. 24.
Pp. 22–24. Brief notes on trials of new strains and hybrids of oats and barley. The origin of the new types is given.

21. 633.13(42.9)
JONES, E. T. 633.13:575(42.9)
New varieties of white winter oats.
Welsh J. Agric. 1932 : 8 : 102–24.

These two new varieties originated in a cross made in 1920 between Grey Winter and Kyko, the former parent being characterized by winterhardiness and the latter by whiteness of grain and reasonably good strength of straw. The breeding history is briefly traced. Selection for winterhardiness and other desirable characteristics including resistance to lodging resulted in the production of two new varieties designated Aberystwyth White Winter Oats S. 81 and S. 82 which on the basis of the trials up to the present are regarded as equal in hardiness to Black Winter oats and ranking next in winterhardiness to Grey Winter.
Short descriptions of the two new varieties are appended.

22. JONES, E. T. 633.13:581.162.32
Natural crossing in oats.
Welsh J. Agric. 1933 : 9 : 115–32.

From 1925-1929 the Welsh Plant Breeding Station carried out an investigation of the frequency of natural crossing in oats. Of 11 white-grained varieties 6, Early Ripe, Red Algerian (*A. sterilis culta*), Garton's Early, Victory, Kösthavre, Scotch Potato (*A. sativa*) contained a number of black-grained hybrid plants, while *A. brevis*, *A. nuda*, *A. sterilis culta* var. Red Rustproof, and *A. sativa* varieties Yielder and Record shewed no natural crossing. It is not, however, clear whether the absence of natural crossing in these varieties was due to an inherent freedom from susceptibility to cross-pollination or to restricted pollen dispersion or some similar cause in the black varieties individually paired with the whites.
The lowest percentage 0·003, of hybrids was found among the var. Scotch Potato (*A. sativa*), and the highest percentage, 0·33, among Early Ripe (*A. sterilis culta*). The early varieties shewed a relatively higher proportion of natural crosses than the late ones though in both groups some varieties shewed no crossing. As regards proximity as a causal factor, it was found that natural crossing was as readily effected between plants in adjacent drills as between individuals within the same drill. Out of the 43 natural hybrids obtained in a total of 115,920 plants examined, 38 occurred in the varieties Early Ripe, Garton's Early and Victory.
The percentage of natural crossing recorded at different geographical centres (U.S.A., Norway and Canada) is also briefly discussed.
The important bearing of these findings upon the production of pure stocks is evident from the fact that under the conditions of the experiment 14 stocks out of 73 among varieties shewing some degree of crossing were observed to be impure ; and if the varieties shewing no crossing be included with those in which natural crossing occurred, then 10 per cent of all stocks grown in alternate drills exhibited some degree of impurity due to crossing. Natural cross-pollination must therefore be regarded as a factor definitely affecting the production of pure stocks of certain varieties grown in adjacent drills.

MAIZE 633.15

23. 633.15:575.42
FISHER, R. A. 575.4:576.12
Number of Mendelian factors in quantitative inheritance.
Nature 1933 : **131** : 400–01.

It is evident from F. L. Winter's experiment on the effects in maize of selection for high and low protein content and high and low oil content that mass selection may lead to very marked differences in quantitative characters and that the selection of very small differences may ultimately result in differences which might well prove of evolutionary importance.
Moreover selection can in fact produce improvement and not merely the isolation of the best of the existing genotypes. The diversity available as material for selection is not easily exhausted and hence evolutionary progress need not depend on the occurrence of mutations. The least possible number of factors that would explain Winter's case of quantitative inheritance is probably some hundreds or thousands and a similar assumption probably applies to the number of factors influencing the normal development of maize varieties.

This accounts for the efficacy of the selection of minute differences and demonstrates the falseness of the limitations ascribed by early Mendelians to the effects of selection in ignorance of the number and diversity of factors concerned.

24. CHAUDHURI, H. 633.15:581.13:577.8
Influence of nutrition on sexual expression in maize.
Current Sci. Mysore 1933 : 1 : 346–47.
A comparison of the effects of overcrowded and normal pot cultures of maize would seem to indicate that inflorescences in single plants, which had better nourishment than crowded plants, bear mainly male flowers, whereas overcrowding and presumably therefore under-nourishment leads to the development of ♀ flowers.

25. HOLBERT, J. R., ELLIOTT, C. and KOEHLER, H. 633.15–2.3–1.521.6:575
Bacterial leaf blight of dent corn.
Phytopathology 1933 : 23 : 15–16. (Abst.)
Marked differences in reaction to wilt were shewn by the various inbred strains and their crosses.

MILLETS AND SORGHUMS 633.17

26. RANGASWAMI AYYANGAR, G. N., NARAYANAN, T. R. and NARAYANA RAO, T. 633.171:575.11:581.46
The inheritance of characters in *Setaria italica* (Beauv.)—the Italian millet. Part III. Bristles.
Ind. J. Agric. Sci., 1933 : 3 : 207–18.
In two previous papers the inheritance of grain colours and of anther colours in the Italian Millet have been described. The present paper deals with the bristles. The bristle, which is present in all *Setarias*, subtends the spikelet but its origin and significance are doubtful. Evidence, in the fact that occasionally they carry a spikelet at their tips, suggests that they are aborted parts of a fascicle. In number there are only one or two, rarely three or four ; higher numbers up to nine have been recorded by others but have not been met with in the experiments detailed. These bristles differ in length, the longest giving to the inflorescence the appearance from which the popular name of ' fox-tail ' is derived. The inheritance of bristle length is recorded in a number of tables covering six generations. Four groups can be identified ; long, from 7 to 14 mm. with an average of 10·5 mm., medium, from 4·5 to 9 mm. with average 8 mm., short, from 3 to 7 mm. with average 5 mm., and dwarf, from 2·2 to 4·5 mm. with average 3·2 mm. The genetic constitution which explains the observations involves four factors. The presence of bristles is ascribed to a factor X with which may be associated a factor E whose existence determines the expression, both potential and actual, of the other factors contributing to length. Two further factors, designated L_1 and L_2, acting in conjunction with the basic factors, produce the following results.
Basic factors Xe, L_1 and L_2 give ' short ' bristle when either is present, the two ' shorts ' being indistinguishable.
L_1 and L_2 in conjunction give ' medium ' bristle.
Basic factors XE, L_1 gives ' short ' bristle,
L_2 gives ' medium ' bristle and
L_1 and L_2 in conjunction give ' long ' bristle.
Correlations between bristle characters and grain colours indicate that no linkage exists between the factors concerned and the same is true for the factors for bristle and anther colours.

27. RANGASWAMI AYYANGAR, G. N., NARAYANAN, T. R. and NARAYANA RAO, T. 633.171:575.11:581.46
The inheritance of characters in *Setaria italica* (Beauv.), the Italian Millet. Part IV, Spikelet-tipped bristles.
Ind. J. Agric. Sci. 1933 : 3 : 552–56.
The histology of the bristle in the Italian Millet has been detailed in a previous paper and some observations on the inheritance of the occurrence of spikelets carried at the tip have been noted. The present paper summarizes a further series of observations on the inheritance of this

character. The development of the spikelets varies considerably both in number and in expression, ranging from 80 per cent. to nil and from a small knob to a well developed grain. Two degrees of manifestation are recognized, ' stray,' with sparse numbers and indifferent development, and ' full,' with up to 80 per cent. of the bristles carrying spikelets and 35 per cent of these bearing well developed grains. Since the spikelet leads to a shortening of the bristle, the ' full ' condition is incompatible with a long bristle.
In certain of the families the ' full ' condition was found to be recessive to the ' nil ' condition while in others dominance was incomplete and the intermediate ' stray ' condition was developed, the three classes occurring in the ratio 1 : 2 : 1.

28. Rangaswami Ayyangar, G. N. and Seshadri Sarma, P.
633.171:575.11.061.2:581.46
The inheritance of characters in *Setaria italica* (Beauv.), the Italian Millet. Part V, A type of lax earhead.
Ind. J. Agric. Sci. 1933 : **3** : 557–58.
The paper describes the behaviour of certain selections which were noted as segregating into the normal dense eared form and a lax eared form. The segregation was clear-cut and due to a single factor.

29. Rangaswami Ayyangar, G. N. and Narayanan, T. R.
633.171:575.11.061.634
The inheritance of characters in *Setaria italica* (Beauv.), the Italian Millet. Part VI. Albinism.
Ind. J. Agric. Sci. 1933 : **3** : 559–60.
A note is given of twenty plants in a selection which had been observed to throw albino plants. Of these twenty, eight bred pure green ; the remaining twelve yielded green and albino in the proportion 3 : 1.

30. Rangaswami Ayyangar, G. N., Narayanan, T. R. and Seshadri Sarma P.
633.171:581.162.3
Studies in *Setaria italica* (Beauv.), the Italian Millet. Part I, Anthesis and pollination.
Ind. J. Agric. Sci. 1933 : **3** : 561–71.
The paper records observations made both in the hot and the cold weather. A detailed study of the development of the inflorescence and of the opening of the flower indicates that self-pollination is the rule though cross-pollination is not precluded. The period of flowering occupies 10 to 15 days and is unaffected by the season. There is a definite periodicity in the opening of flowers during the 24 hours, with maxima between 10 p.m. and midnight and between 6 a.m. and 8 a.m. In the hot weather the two flushes are nearly equal in intensity but in the cold weather the second flush is only half the intensity of the first. Anthesis appears to be controlled by the combination of humidity and temperature ; it also appears to be independent of varietal differences.

RICE 633.18

31. Sreenivasan, C. R. 633.18(54.8)
New strains of paddy from Agricultural Research Station, Maruteru.
Madras Agric. J. 1933 : **21** : 191–94.
Short notes on eight strains of rice isolated and tested during the past seven years at the Maruteru Agricultural Research Station, and now available for cultivation. Their characteristics and productivity and the most suitable conditions for their cultivation are described.

32. Grant, J. W. 633.18:575(59.2)
The rice crop in Burma. Its history, cultivation, marketing and improvement.
Agric. Dept. Burma 1932 : Agric. Survey No. 17 : Pp. 52.
Chapter X deals with improvement. Systematic improvement was not begun till 1907 and then only on the crop grown for local consumption. Research on rice for export was started in

1914 and four central stations are now established. The main object is the replacement of the mixtures grown at present by high-yielding strains of good quality by means of pure line selection of the indigenous varieties, tests of foreign sorts and hybridization. At present none of the tropical and sub-tropical varieties tested have proved superior to the pure strains of the indigenous rices and hybridization is still in the experimental stage.

33. MITRA, S. K. and GANGULI, P. M. 633.18:575.061.634
Inheritance of albino and white-striped characters in rice.
20th Ann. Meet. Ind. Sci. Cong. Patna 1933 : Sect. Agric. Abst. 25 : 8–9.
Rice seedlings with white-striped leaves were isolated from among self-pollinated seeds of apparently pure green rice, and when propagated in successive generations retained their peculiar leaf characteristics and also a lighter coloration of the inner glumes in the mature grains. One white-striped plant segregated in a ratio of 3 white-striped : 1 albino in the F_1. Later a pure white-striped strain was evolved. The white-striped character behaved as a recessive to green in natural, artificial and back-crosses.

34. MITRA, S. K. 633.18:575.061.634
Albino and white-striped characters in rice.
Current Sci. Mysore 1932 : 1 : 102–03.
Slightly more detailed though earlier account of the work referred to in the previous abstract.

35. RAMIAH, K. 633.18:575.11–181.13
Inheritance of height of plants in rice (*Oryza sativa* L.)
Ind. J. Agric. Sci. 1933 : 3 : 411–32.
The height of the rice plant is subject to minor variations due to external influences but, in the case of a pure family, these do not exceed one foot. In the case of a cross the inheritance may be simple or complex. Both shortness and tallness may be dominant. In the examples detailed a single factor is dominant for shortness in two cases ; in the remaining cases up to three factors dominant for tallness are responsible for the varying results observed.

36. 633.18:575.11"793"
RAMIAH, K. 633.18:581.162
Inheritance of flowering duration in rice (*Oryza sativa* L.)
Ind. J. Agric. Sci. 1933 : 3 : 377–410.
Previous workers, whose results are here reviewed, have shown that the inheritance of flowering duration in rice may be complicated. In the cases described by the author a similar complexity is found together with cases in which the inheritance is simple. For the purpose of description, flowering duration is defined as the total number of days that elapse between sowing the seed and the beginning of the flowering phase. A further preliminary observation is made that the flowering duration is influenced by various external conditions, notably distance of spacing, fertility of the land and, particularly, time of planting. Thus, in the example given, early sowing (1st June) gave a flowering duration of 138 days, normal sowing (1st Sept.—1st Dec.) 90 to 95 days and late sowing (1st Feb.) 224 days. To eliminate such causes of variation the parental types were sown each year.
Two cases in which inheritance of a simple character appears to be involved are described in detail. In one of these the F_2 gives a bimodal curve with an approximate 3 : 1 ratio early to late, with the minimum frequency at 122 days. All early parents below 109 days and all late parents bred true in the F_3, but the extracted early has a higher mean than the early parent and the extracted late a lower mean than the late parent. In the second case observation is limited to the F_3 and F_4, but appears to be uniform with the other.
Six examples of more complex inheritance are recorded. The degree of complexity varies, transgressive inheritance becomes frequent and, in some, the F_2 exhibits a monomodal curve. They are explained by various combinations of factors for earliness (E) together with a factor (L) for lateness with E_1 dominant to L and L dominant to E_2, and a factor I inhibiting L. The analysis is in accord with earlier observation that lateness is sometimes dominant.

37. RAMIAH, K. 633.18:575.113.6–181.13:575.11"793"
Inhibitory factor hypothesis and the inheritance of flowering duration and plant height in rice (*Oryza sativa* L.).
Ind. J. Agric. Sci. 1933 : 3 : 446–59.

In the course of the investigations on the inheritance of flowering duration and height two crosses having one parent in common occurred in one of which simple dominance of short early over tall late was found while, in the other, simple dominance of tall late over short early. There were thus obtained four types, dominant and recessive short early and dominant and recessive tall late. The present paper describes a number of crosses between the two pairs. The results are explainable both on a multiple-factor hypothesis and also on an inhibitory factor hypothesis, the existence of an inhibitory factor, I, which inhibits the factor, L, for lateness and height. There is, however, a certain amount of overlap between the two groups and this is, perhaps, best explained on the former hypothesis.

38. RAMIAH, K. 633.18:575.116.1–181.13:575.116.1"793"
Genetic association between flowering duration and plant height and their relationship to other characters in rice (*Oryza sativa* L.).
Ind. J. Agric. Sci. 1933 : 3 : 433–45.

In the two previous papers the observations on flowering duration and height are described as independent phenomena and their interrelation merely noted. In the present paper this interrelation is discussed in greater detail and a number of other cases recorded. In general there is a positive correlation between height and flowering duration but this is not invariably the case, the extent to which this correlation is dependent on linked factors is not clear and both may be dependent on a deeper physiological character. That this is so is suggested by the case where the pure short earlies of a cross show a positive correlation while the pure tall lates of the same cross show a negative correlation ; the former resulting from the inability of an early plant to develop height in the limited period of growth and the latter from the greater vigour of the earlier plants. In crosses between varieties, all fairly long, at Maruteru negative correlations varying from –0·25 to –0·62 were obtained.

Significant correlations have also been found to exist between the above two characters and the emergence of the panicle as well as panicle length. For one cross in which the correlation between flowering duration and height had been determined as + 0·27, the partial correlation, eliminating panicle emergence and length, was found to be + 0·42.

A like association was also found to exist between these two characters and certain morphological characters. Tests of independence applied to families containing gold and brown glumed plants shew a definite association of the inhibiting factor I, which is responsible for the gold colour, with height, while the nature of their association with the factor R, which produces red rice, the nature of the straw as affecting lodging and yield is also briefly discussed.

39. HEDAYETULLAH, S. 633.18:575.12:576.312.315
A cytogenetical study of the behaviour of nucleoli in the pollen mother cells of three varieties of rice (*Oryza sativa* L.) in the parent plants and in their hybrids.
20th Ann. Meet. Ind. Sci. Cong. Patna 1933 : Sect. Bot. Abst. 52 : p. 19.

Pollen of the variety Kochivittu which has two large nucleoli of equal size, when crossed with the variety Nabata which has one large nucleolus or the variety White aus with two unequal nucleoli, gives hybrids with two unequal nucleoli in the pollen mother cells in all cases.

40. RAMIAH, K. and DHARMALINGAM, S. 633.18–2.183:575
Lodging of straw and its inheritance in rice (*Oryza sativa*).
20th Ann. Meet. Ind. Sci. Cong. Patna 1933 : Sect. Agric. Abst. 24 : p. 8.

Various common types of lodging found in a number of rice varieties at the Coimbatore Breeding Station are described. No single morphological characteristic can be regarded as diagnostic of the tendency to lodging, but certain structural criteria are mentioned which all appear to indicate resistance.

Genetically, non-lodging proved to be a simple recessive character which in the F_2 generations exhibited an association with tillering, plant height, etc.

LEGUMINOUS PLANTS 633.3

41. MARSDEN-JONES, E. M. and TURRILL, W. B. 633.362:575.2
633.362:575.12

Studies in variation of *Anthyllis vulneraria*.
J. Genet. 1933 : 27 : 261–85.

This study includes :—
(1) Botanical descriptions of selected stock-plants of varieties of the common Kidney Vetch as it is found in the south of England, (2) results of selfing most of these varieties under control, (3) the analysis of generations from wild seeds of known origin from single plants and (4) studies of wild populations. The species is very polymorphic, especially in habit and flower colour. Apart from its interest to taxonomists the paper has a bearing upon the origin of hybrid phenotypes and definitely confirms the value of combining field studies with breeding work.

ROOTS AND TUBERS 633.4

42. BLACK, W. 633.491:575.061.6

Studies on the inheritance of tuber colour in potatoes.
J. Genet. 1933 : 27 : 319–39.

A series of experiments undertaken primarily to obtain new economic types offered an opportunity for the study of colour inheritance in potato tubers. As regards red tuber coloration, the selfing and crossing of white tubered seedlings resulted in progenies containing various proportions of seedlings with coloured tubers and seemed to indicate (1) that the action of complementary factors underlay the various types in red coloured tubers, and (2) that a white tubered variety may contain a latent factor for colour which may appear in the phenotype on self-fertilization.
No pure breeding red tubered varieties were obtained but the self-fertilization of " red " seedlings and crossing with white seemed to shew colour in potato tubers to be dominant to absence of colour.
While the four types of whites that were distinguished by their progeny on self-fertilization indicated the presence of some factor inhibiting pigment in the parent self-fertilization of the coloured types gave five different ratios in the progenies, thus suggesting the presence of more than one factor for red pigment. The factors postulated as conditioning red pigment are :— D, a basic factor incapable of producing pigment alone ; R, a red-colour–producing factor, incapable of producing pigment alone, but in the presence of D giving a red coloration ; and H, an inhibitor which, when heterozygous, is incompletely dominant to either D or R when one of them is homozygous ; or when homozygous is incompletely dominant when both D and R are homozygous.
The genetic analysis of blue colour seemed to point to a factor for blue colouring, P, epistatic to the red factor. This factor P functions only in the presence of both D and R and reacts to the presence of D and H in a manner similar to R. All varieties, whether blue or white skinned, if carrying a factor for blue had blue coloured sprouts.
It was found necessary to postulate a second blue colour factor, B, similar in effect to the factor P, in order to explain certain exceptional results obtained with two varieties.

43. O'CONNOR, C. 633.491–2.411.4–1.521.6:575

Potato breeding and resistance to blight.
Gdnrs.' Chron. 1933 : 93 : 104–05.

For some years the Plant Virus Disease Research Institute, Cambridge, has been engaged in the study of the inheritance of resistance in potatoes to *Phytophthora infestans*, with the ultimate object of producing a new variety of good economic qualities and resistant to both common blight and wart disease. As initial breeding stock for blight resistance *S. demissum* is used since European domestic stocks are regarded as unlikely to possess this genetic character.
A rapid method of testing seedlings for blight resistance was introduced by Dr. Salaman in 1928 and is based on Dr. Müller's method.

The test is severe, and the majority of the few seedlings that survive belong to hybrid families and often exhibit undesirable wild characters. The most promising of these seedlings are grown on from tubers in the following season to be backcrossed with domestic varieties. The F_1 of resistant x susceptible is usually 100 per cent susceptible, resistance to blight having been previously found to be recessive. The F_1 seedlings are planted out in close proximity to potatoes suffering from virus disease so that those which prove least susceptible to the virus can be selected as parents from which to breed.

Every degree of resistance has been found in the hybrid families raised ; and loss of resistance has been observed in seedlings selected in the F_5, F_6 and F_7 families from the *S. demissum* x domestic cross. Nevertheless several seedlings of the 6th and 7th generations from this cross have proved remarkably resistant for two years and also possess promising economic characters. Moreover, one strain has proved resistant to a new form of *Phytophthora infestans* which recently destroyed large numbers of hitherto immune seedlings.

FIBRES 633.5

44. Afzal, M. and Trought, T. 633.51:575.127.2
A note on a cross of *Gossypium stocksii* M. Mast. with *Gossypium indicum* Gammie.
Ind. J. Agric. Sci. 1933 : **3** : 334–38.

Considerable difficulty has been experienced in crossing *G. stocksii* with other Indian cottons but, from 27 flowers of a local form of *G. indicum* derived from Sind, a single boll containing four viable seeds was obtained. The nine flowers representing the reciprocal cross all failed to set. Of the four plants raised three were stunted and looked like the *stocksii* parent ; the fourth was a tall, vigorous plant. At the time of writing, only the latter had flowered and it failed to set bolls. A detailed description is given of the parents and the two types of F_1 plants. No satisfactory explanation of the divergent types in the F_1 has been found, but the back-cross, which has not been made so far, may throw light on the subject.

45. Patel, S. J. 633.51:575.127.2
The F_1 generation of a hybrid between an American and an Asiatic cotton.
Ind. J. Agric. Sci. 1933 : **3** : 127–30.

The paper is composed of a description of a single plant obtained from the cross, Bourbon (*G. purpurascens*) x Wagad 12 (*G. herbaceum*). Both parents are early flowering forms, the Bourbon, with the first sympodium at the 18th node or above, flowering some 15 to 20 days later than Wagad with the first sympodium at the 14th node on the average. Corresponding details are given of a number of characters of the two parental types and of the cross.

46. 633.51:575.42:631.525:575.2
The acclimatization of cottons in new areas.
Emp. Cott. Grow. Rev. 1933 : **10** : 206–07.

Dr. Harland in reply to a letter pointing out that various American cottons have been introduced with success into certain African colonies. It is shewn that these varieties have mostly been introduced from some other African colony, probably after contamination, and not direct from America, thus supporting his original thesis (see " Plant Breeding Abstracts," Vol. III, Abst. 156).

47. Banerji, I. 633.523:576.312
The development of flower and pollen in jute.
Ind. J. Agric. Sci. 1933 : **3** : 116–26.

Though a considerable amount of work has been done on the improvement of the Jute plant and certain observations have been recorded on inheritance of some of the more prominent characters of the two species, *Corchorus capsularis* and *C. olitorus*, cytological investigation was wanting

and it was merely known that the two species were not inter-fertile. The present paper partly fills the gap. In both species the haploid chromosome number is given as 7 and, in the case of *C. olitorius* a detailed description is given of the development of the flower from the bud and of nuclear development in the formation of the pollen grains, material being taken from the variety known as " Chinsura " Green. The various phases of meiosis follow in normal succession and exhibit no aberrant phenomena.

48. 633.524.1:576.312.35
RAMANUJAM, S., PARTHASARATHY, N. and RAMIAH, K. 633.524.1:576.354.4
Chromosome studies in some species of *Crotalaria*
20th Ann. Meet. Ind. Sci. Cong. Patna 1933 : Sect. Agric. Abst. 26 : p. 9.
Four species including *C. juncea* were found to have eight as the haploid number of chromosomes. Meiosis in the pollen mother cells is fully described.

49. BARKER, S. G. 633.526.23:581.16
Sisal. A note on the attributes of the fibre and their industrial significance.
H.M. Stationery Office, London, 1933 : 1s. 0d. Pp. 80. E.M.B. 64.
A general study of the plant and its fibre, including a brief section in which the development of the flowering stem from the terminal bud is briefly described. At high altitudes reproduction may occur by seed, but the setting of seed is otherwise rare, the more usual method being by the development of " bulbils " in the axils of the flower stalks. From 2,000 to 4,000 of these buds or small plants may be produced on one " pole " (or flowering stem). The bulbils become detached from the tree and under favourable conditions take root in the soil. Reproduction by suckers from the rhizome also occurs. If detached from the parent and planted these suckers often grow ; but if left attached to the parent they soon die. According to F. J. Natman " the poling tendency of the parent plant is transmitted through the suckers and the offspring may all pole simultaneously with the parent."

SUGAR PLANTS 633.6

50. VENKATRAMAN, T. S. and HUSSAINY, S. A. 633.61:575:578.08
Sugarcane varietal trials for selecting suitable improved types.
Agric. and Live-st. Ind. 1933 : **3** : 1–15.
In the period of protection afforded to the Indian sugar industry it is necessary to place the industry on a competitive basis and, for this, the first essential is the evolution and selection of canes suited to the different tracts. The paper describes a system for the rapid determination of this suitability.
Canes are best imported in small quantity and multiplied up locally. They should then be planted in uniform plots with the standard local cane for comparison.
Germination counts should be continued for a period of 6 weeks and standardized to the number of sprouted buds relative to the number planted since sets may contain varying numbers of buds.
In the growth studies particular attention should be paid to critical periods and the behaviour of the canes when conditions are adverse and the tests should be continued to include one or two bad years.
In the method described rows of 10 to 20 plants are laid down and periodic records are taken of habit, weight of shoot as determined by weight of a single row, tillering and root development, the last determined by digging a lateral trench. Periodic juice analyses, brix and sucrose by direct polarization, reduced to fortnightly intervals during the ripening period are made. Lastly, new canes should be followed up in the cultivators' fields.

51. 633.61:576.312.35
DUTT, N. L. and SUBBA RAO, K. S. 633.61:581.162.4
Observations on the cytology of the sugarcane.
Ind. J. Agric. Sci. 1933 : **3** : 37–56.

This paper records observations on the fertilization and embryogeny of the sugar cane. Chromosome numbers in Puri, Vellai and Shamshara were found to be 40 haploid and about 40 in Poovan and Chittan. In *S. spontaneum* (Coimbatore) the haploid number was 32 and in Co. 205, a cross between this plant and Vellai, 56. Following Bremer's determination of the relationship between size of microsporocyte nucleus and the haploid chromosome number, a number of corresponding determinations are given, which lack, however, the same degree of fit. In the course of the work an abnormal embryo-sac with the antipodal nuclei at the micropylar end was observed.

Previous observations as to the time taken by the pollen tube to reach the embryo sac are corrected. This time was found to be 7½ hours. A number of further observations are added to those previously recorded of the presence of more than one male generative nucleus and in one case four have been observed within the embryo-sac. In the course of the examination of preparations two cases of apparent apogamy were noticed and one of polyembryony in which two embryos occurred in the embryo-sac.

The paper concludes with a broad discussion of the bearing of the observations on the origin and relationships of the forms of the genus *Saccharum*.

52. KHANNA, K. L. 633.61:581.462:575
Multiple buds in sugarcane—their inheritance and growth.
20th Ann. Meet. Ind. Sci. Cong. Patna 1933 : Sect. Agric. Abst. 37., p. 13.

On experimental evidence it is concluded that the abnormality which consists in the production of double or multiple eyes at the stem nodes is probably not hereditary and may be due to some growth disturbance.

53. GREENSTREET, V. R. and LAMBOURNE, J. 633.682(91)
Tapioca in Malaya.
Gen. Ser. Dept. Agric. S.S. and F.M.S. 1933 : No. 13 : Pp. 76.

The object of this pamphlet is to provide " reliable data on the cultivation, food requirements, characters, manufacture and economics " of tapioca in Malaya. Brief remarks on the botanical characters, reproduction and pollination and the possibilities of selective breeding are included, with notes on existing varieties in Malaya and their classification.

STIMULANTS 633.71

54. 633.71:575.115
BHALERAO, S. G. 633.71:575.114
Variations in the mode of inheritance of certain characters in tobacco.
20th Ann. Meet. Ind. Sci. Cong. Patna 1933 : Sect. Bot. Abst. 57 : p. 21.

Certain characters of *Nicotiana tabacum* when studied each in about eight crosses shewed in F_1 intermediate, sub-dominant, dominant or super-dominant inheritance, while in F_2 either mono-hybrid Mendelian segregation or various types of transgressive segregation was observed ; and in F_3 the typical multiple factor effects were exhibited.

The variations appear to be less pronounced in F_2 and F_3 and no definite interrelation between the mode of inheritance in the three generations could be ascertained.

In the author's opinion, owing to the differences noted in the mode of inheritance of the same character in various crosses no general deduction as to its inheritance can be made.

OIL PLANTS, ETC. 633.842

55. DESHPANDE, R. B. 633.842:575.11
Studies in Indian chillies. (3) The inheritance of some characters in *Capsicum annuum* L.
Ind. J. Agric. Sci. 1933 : **3** : 219–300.

The paper is a lengthy account (pp. 81) of a study of inheritance in a cross between two of the Pusa Types, Types 3 and 29, of chillies, the results of which are in the main confirmatory of

previous investigations in America, Japan and England. Observations extend to the F_3 and back-crosses. The conclusions arrived at are that :—
The purple colour which is characteristic of Type 3 and extends to all organs of the plant, is determined by two factors, (A), producing the purple colour, and (B), an intensifier which is inert by itself. In the case of both factors the heterozygous condition is intermediate and, further, a single dose of (A) is of greater effect than a double dose of (B). Three grades of purple can, thus, be recognized.
Fruit position, whether pendent (P) or erect (p), is inherited on a simple monohybrid basis.
The colour of the fruit, whether red (R) or yellow (r), is inherited in similar manner but there are indications of a weak linkage between (R) and (A).
Other factors exhibiting simple monohybrid inheritance are : (D), producing a blunt fruit apex, (F) producing a bulged fruit base and (E), causing the calyx to enclose the fruit base. A close linkage exists between (F) and (e).
Of qualitative characters, length of fruit is inherited on a tri-hybrid basis but exhibits linkage between short fruit and purple colour and between long fruit and the pendent position ; fruit thickness (largest diameter in cross section), petal length and pedicel length are claimed to be inherited on a mono-hybrid basis with linkage between thickness and petal length (f) and (a), and between short pedicel and (A).
Heterosis is exhibited by the F_1 in vigour, maturity, height of plant, productivity and thickness of fruit.

56. BANERJI, A. R. 633.842:576.312.34
The chromosome association at diakinesis in *Capsicum annuum*.
20th Ann. Meet. Ind. Sci. Cong. Patna 1933 : Sect. Bot. Abst. 73 : p. 25.
Observations of diakinesis and stages leading up to heterotypic metaphase revealed chromosomes of at least four different lengths exhibiting various types of chiasmata. The chromosome complex may be represented as $4L_2 + 4M_2 + m_2 + 3S$, where L = the longest, M = the medium, m the next medium sized and S the shortest chromosome type.

57. MASUR, N. G. 633.853.55:575 ( )
Castor-breeding in the Bombay Presidency.
Agric. and Live-st. Ind. 1933 : 3 : 125–43.
This is a record of breeding investigations having as their main object the improvement of the commercial crop. Observations on numerous characters of the castor plant are recorded but no detailed study of their inheritance is made. From a large number of samples of castor seed collected from many sources strains have been isolated with precautions which ensure self-fertilization, and from these the most promising from the commercial aspect have been selected for further cultivation.
A major section is devoted to a discussion of the factors affecting yield. The number of fruits per inflorescence varies greatly, ranging from 5 to 165 for the terminal inflorescence with a single mode at 25. Compactness of the inflorescence is also variable and may be expressed as the number of fruits per linear measure of the axis though the matter is complicated by the irregular distribution of the male flowers in certain forms ; cases of dioecious plants and hermaphrodite flowers are recorded.
There appears to be a fair varietal constancy in the number of nodes and a like varietal constancy in the number of branches of the first order developed leading to sparsely branched and bushy types. Inflorescences may occur on branches to the fourth order and it is noteworthy that it is the sparsely branched forms that produce inflorescences most freely on the branches of the higher order.
Seed size is closely correlated with seed weight and forms a varietal character.
Where the growing season is limited earliness is an important factor bearing on yield and also has varietal significance, the range extending from 35 to 105 days between sowing and the appearance of the first inflorescence.
Observations on oil content and its inheritance are recorded but add little to the information already available. It is concluded that it is possible to isolate strains having a high oil content.

58. DWYER, R. E. P. and BOWMAN, F. T. 634.13:581.162.5
Pollination of Packham's Triumph pear. Final results of investigations at Bathurst Experiment Farm, 1927-32.
Agric. Gaz. N.S.W. 1933 : **44** : 516–26.

From experiments conducted from 1927 to 1932 at Bathurst Experiment Farm it became clear that the variety is to a great extent self-unfruitful, only 1·44 per cent set being obtained from over 7,000 pollinated blossoms ; true self-fertility as indicated by the seed content of the few fruits formed was also of a low order.

Cross pollination gave a set of 17·28 per cent, and also a much higher seed content in the hybrid fruits which were superior in quality too.

In the cross-pollination experiments artificial crossing resulted in four times as large a set as that obtained by natural means. Possible explanations of this phenomenon are offered.

In commenting on the varieties found to be suitable for pollinating Packham's Triumph, the variety Josephine de Malines is specially recommended. The results of the tests of the reciprocal crosses are recorded in some cases but are not yet complete for all the varieties used.

59. 634.23:581.331.21:576.356.5
634.22:581.331.21:576.356.5
AFIFY, A. 634.11:581.331.21:576.356.5
Pollen tube growth in diploid and polyploid fruits.
J. Pom. Hort. Sci. 1933 : **11** : 113–19.

Pollen tube growth was studied in certain varieties of cherries (2n = 16), plums (2n = 48), and apples (probably secondary polyploids). Various types of pollen grain and behaviour accompanied by corresponding degrees of incompatibility or fertility were observed in each of the three kinds of fruit.

In the diploid cherries the incompatibility behaviour is fairly simple ; no intermediate grades of growth occur, the pollen tube being either totally inhibited or not inhibited at all. In the plums which were hexaploid it is possible that six incompatability factors were influencing pollen tube growth, so that several gradations in the latter function might result ; and five types were distinguished. In the apple varieties investigated the pollen grains exhibited four different types of pollen tube growth ; and this is explained on the basis of the cytological findings of Darlington and Moffett that the varieties in question are secondary polyploids.

60. 634.58:581.14
ALI MOHAMMAD, ALAM, Z. and KHANNA, K. L. 634.58–1.547.1
Studies on germination and growth in groundnut (*Arachis hypogaea* Linn.).
Agric. and Live-st. Ind. 1933 : **3** : 91–115.

The process of germination and the effects of certain preliminary treatments such as stripping and shelling are described. Growth was compared in three varieties, Burmese, Small Japan, and Small Spanish ; and root and shoot development and its relation to soil types are dealt with.

61. 634.61–1.521.1
SMITH, A. C. 634.61:575.42
Practical seed selection of coconuts.
Malayan Agric. J. 1933 : **21** : 265–71.

Little is known of the genetics of the coconut except that normally the tall coconut is almost exclusively cross-pollinated. The Department of Agriculture at the Klang Experiment Station is engaged in the production of a pure line, but the time required to obtain two generations and the fact that vegetative propagation is impossible makes the question of seed selection and its possibilities of special interest to estate owners.

Having indicated the disadvantages of the methods of seed selection such as mass and individual plant selection from high yielding areas as hitherto practised on European estates in Malaya, a practical scheme for seed selection is outlined. Owing to the very great variation in the meat content of nuts even from high yielding trees a detailed examination of palms for the number of nuts and for copra yield is essential. In planting, 100 per cent in excess of the required number

of plants should be laid down to allow for losses due to poor germination or defective growth, etc. The results of the planting of seed from each mother palm will indicate the value and potentialities of the available material for future selection.
Full particulars are given of the author's application in practice of this method which he recommends as also possible on a commercial scale.
Careful seed selection should lead to a definite improvement in quality if the characters of the high yielding ♀ parent are transmitted in the majority of cases, and with the ♂ parent also from an area with superior yields the productivity should be improved.
Incidentally it was found in the course of the above investigation that (1) contrary to general opinion oval nuts are as likely as round nuts to have a satisfactory meat content ; (2) large nuts shewed a smaller percentage of germination and fewer strong healthy plants than did nuts approaching average size ; and (3) colour apparently has no relation to the value of the nut.

62. CHEESMAN, E. E., WARDLAW, C. W. and SPENCER, G. L. 634.771:576.16
The Cavendish group of banana varieties with special reference to Lacatan.
Trop. Agriculture 1933 : **10** : 218–21.
From prolonged investigations including field comparisons, physiological and morphological observations, and sterility phenomena it is concluded that Lacatan, Bumulan, Giant Fig and Masak Hijau are actually one and the same variety which would be best designated Lacatan. This variety and all the dwarf, semi-tall and other tall forms are regarded as constituting one genetic group termed the Cavendish group.

VEGETABLES 635

63. 635.64:581.141
BHADURI, P. N. 635.64:581.162.4
The development of endosperm and fertilization in Solanaceae.
20th Ann. Meet. Ind. Sci. Cong. Patna 1933 : Sect. Bot. : Abst. 63 : 22–23.
Endosperm development is described and double fertilization studied in three species including *Lycopersicum esculentum* in which the new type of double fertilization described by Ferguson in *Petunia* was found. The sperms generally enter the embryo sac 96 hours after anthesis and triple fusion usually occurs 120 hours after the flower opens.

64. 635.64:581.321.1
BHADURI, P. N. 635.64:581.331.1
The development of the ovule and embryo sac in the Solanaceae.
20th Ann. Meet. Ind. Sci. Cong. Patna 1933 : Sect. Bot. : Abst. 64 : p. 23.
Ovule and embryo sac development has been investigated in *Solanum nigrum*, *Lycopersicum esculentum*, *Nicotiana plumbaginifolia* and other varieties, and general conclusions drawn.

65. JANNAKI AMMAL, E. K. 635.646:575:576.16
The genetic analysis of some races of eggplant *Solanum Melongena* Linn.
20th Ann. Meet. Ind. Sci. Cong. Patna 1933 : Sect. Bot. : Abst. 93 : p. 31.
Local varieties of *Solanum Melongena* shew fixed characteristics. Thirty-two varieties from India, China, Japan and America were grown to see how far they bred true to their types and crosses were made between strikingly different ' races.'
White or ' Ivory ' fruit is due to the absence of chlorophyll in the walls of the pericarp. It is a recessive character and gives a monohybrid ratio when crossed with a green fruited variety. Anthocyanin colour in the pericarp may be associated with either ' Ivory ' or green fruit and gives a dihybrid ratio when crossed with varieties in which anthocyanin is not developed. The presence of chlorophyll acts as an inhibitor in certain genotypes.

66. 635.65:576.312.35
BASUDEV ROY 635.65:581.331.1
The development of the female gametophyte in some leguminous crop plants of India.
20th Ann. Meet. Ind. Sci. Cong. Patna 1933 : Sect. Bot. : Abst. 65 : p. 23.
In the course of this physiological study the haploid chromosome number in ***Pisum sativum*** and in *Lathyrus sativus* was found to be seven whilst in *Cajanus indicus* it was eleven.

67. RHIND, D. 635.653:575.11.061.6:581.48
A note on the inheritance of seed-coat colour in *Phaseolus lunatus* L.
Ind. J. Agric. Sci. 1933 : 3 : 360–64.
Two varieties of *P. lunatus* are cultivated in the dry zone of Upper Burma and are known respectively as Rangoon White Bean (*pebyugale*) and Rangoon Red Bean (*pegya*). The latter is hardy and bears small coloured seed of which the colouring may be purple or rose and the seed itself speckled or self coloured. Whatever the colouring, it is borne on a buff ground. *Moki Lima* is a variety imported from Egypt and having a large white seed. Observations are recorded of crosses between *pegya* and *Moki Lima*.
When plants of the two varieties were allowed to grow intertwined, 4·85 per cent coloured seed occurred in the *Moki Lima* variety and 18·42 per cent large seeds in the *pegya* variety. Artificial fertilization, which is not easily performed, must, therefore, be adopted. These observations, which include the F_3 generation, indicate that three factors are involved in the determination of testa colour ; (R), producing rose colour, (P), an intensifier converting the rose colour to purple and (S), producing the speckled pattern. The factor (S) exhibits partial dominance, and, in the homozygous condition, causes a large degree of colour suppression.

68. SHAW, F. J. F., KHAN, A. R. and SINGH, H. 635.659(54)
Studies in Indian pulses, (3) The types of *Cajanus indicus* Spreng.
Ind. J. Agric. Sci. 1933 : 3 : 1-36.
General information on the possible origin and cultivation precedes a note on pollination (including the extent of natural crossing) as observed under conditions in Bihar and a full description of the morphological characters with a key to the various types and also a descriptive list of 86 of them.
The question of wilt resistant forms is touched upon.

69. ALAM, M. 635.659–1.521.6:581.162.5
Rahar sterility.
20th Ann. Meet. Ind. Sci. Cong. Patna 1933: Sect. Agric.: Abst. 43: 15–16.
The type of sterility in question is characterized by (1) dwarfing of leaves, (2) a bushy habit and (3) yellowish green instead of green leaves. The accompanying sterility due to the suppression of flowers and fruits may vary in degree in different types of *Cajanus indicus*, but the relative sterility of the different types is more or less constant from year to year, certain types exhibiting a high percentage of sterile plants and others a low percentage regardless of soil and climatic conditions. A negative correlation between the degree of sterility and yield was noted.
Certain practically immune types exist while other varieties are highly susceptible and among the latter type even plants apparently free from the defect may produce sterile progeny.

Part II. Foreign

STATISTICS 519

70. MORI, H. 519.241.1
(Tables of values of log $(1-r^2)^{\frac{1}{2}}$, for the calculation of coefficients of partial correlation.)
Jap. J. Genet. 1933 : 8 : 131–36.
The tables are to seven places of decimals, for r from 0·001 to 0·999 at intervals of 0·001.

GENETICS 575

71. KÜHLE, L. 575(43)
Fünfundzwanzig Jahre Gesellschaft zur Förderung deutscher Pflanzenzucht.
(Twenty-fifth Anniversary of the Society for Promotion of Plant Breeding [in Germany]).
Züchter 1933 : 5 : 121–23.
On the occasion of the 25th anniversary of the foundation of the society various milestones are traced on the road leading from the primitive methods of selection to plant breeding as it is known to-day.
The true beginnings of scientific plant-breeding date from 1889 when Rümker published his work on rye. Whereas the breeding of fodder crops was developed later than any of the other branches of the science, breeding of vegetables and flowers represents the oldest form of plant breeding in Germany and originated in the work of experienced and expert gardeners.
Finally the re-discovery of Mendel's laws made of plant-breeding a science which has been ably developed by later workers and by the famous genetic institutes at Dahlem and Müncheberg, and the Biologische Reichsanstalt under Dr. Appel who was instrumental in founding the breeding society. The survey closes with a plea for still closer co-operation between science and practice.

72. KARPECHENKO, G. D. 575:633(47)
(Plant genetics in the U.S.S.R.)
Bull. Appl. Bot. Leningrad 1932 : Ser. A (4) : 101–14.
The rise in importance of plant genetics in the Soviet Union in recent years is traced briefly. Interspecific and intergeneric hybridization is mentioned as one of the branches in which the Soviet Union has made the most outstanding contributions, the wheat-rye hybrids and the constant cabbage-radish hybrids being given as an instance. The author has also obtained hybrids of radish x cabbage x mustard, radish x cabbage x rape x turnip, etc.
Reference is made to the demonstration of the composite nature of the chromosome set of *Aegilops persica* which Senjaninova-Korchagina on the grounds of chromosome morphology has shewn to consist of *Ae. caudata* and *Ae. umbellata* ; Sorokina has moreover produced the first of these species artificially by crossing the two latter species.
The importance of morphological changes in the chromosomes in the differentiation of species is also emphasized.
The different coloration of the chromosomes of different parents observed in interspecific *Vicia* hybrids is also mentioned, also hybrids of *Triticum durum* x rye x *T. vulgare* which were 20 per cent fertile.
Amongst interesting mutations are mentioned a giant oat mutant, the vegetative potato mutants of Asseyeva and a cabbage with doubled chromosome number induced in the author's laboratory by decapitation. The latter mutant is larger, with larger cells, and more succulent than the normal, and crosses easily with the Abyssinian mustard, Chinese cabbage and *Raphanobrassica*. The first of these three is very vigorous in growth and if constant forms are obtained they will make excellent silage. Reduced temperature is a promising method for inducing polyploidy, instances of its use being given.
X-ray mutants are referred to, amongst which early-maturing and stiff-strawed forms of wheat

obtained by Delaunay are singled out, also a cold-resistant wheat obtained by the same means. Extensive experiments on the induction of mutations by various agents are in progress.
The names of those workers engaged in genetic studies on the various crops are given.
The primary importance of geographical studies in providing the material for scientific breeding is emphasized. The author has crossed endemic forms from different countries, e.g. a Japanese barley var. *Dundar-beyi* Zhuk. with an Afghan form var. *sublatiglumatum* Vav., in the second generation of which pronounced transgressive segregation occurred for height, ear length, number of spikelets, time of maturity, with all intermediate forms, the majority also segregating further in the F_3. Such studies will shed great light on the origin of the different geographical groups.

73. ANDERSON, E. 575.061.6:581.08
A convenient color chart for geneticists.
Science 1933 : **78** : 150–51.
The " Fischer Color Chart " is roughly quantitative and consists of a radial arrangement of 18 colours, each with 7 shades. An approximate match is rapidly obtained except for peculiar colours such as those found in Nicotiana hybrids, to which the chart is unsuited. It is cheap and convenient, does not readily fade, and may be obtained from the Secretary of the New England Gladiolus Society, Mr. C. W. Brown, 13, Park Road, Ashland, Massachusetts.

74. DUBININ, N. P. 575.1
(Certain fundamental problems of genetics.)
J. Biol. Moscow 1932 : **1** : 112–47.
The early developments of the theory of inheritance are outlined, leading up to the very latest developments and theories.
The author views the gene as the unit of which the chromosomes are constructed ; " the individuality of the gene is proved by the process of its mutation, its significance in phenogenesis, etc." The gene itself may be a complicated genetical system however and not the ultimate genetic unit. Although the necessity of a limit of divisibility is admitted, this does not essentially coincide with the gene.
The next great step in genetic study is the investigation of the stages which connect the gene as a unit of the chromosome and its expression in the phenotypic characters of the organism.
Considerable space is devoted to discussion of the genetics of populations, referring to work of the author and others which, in contradiction of the views of Serebrovsky, has shewn that a population not subjected to selection after a certain number of generations reaches homozygosity, the proportion of recessives being determined by the proportion of the recessive genes in the initial population. In nature there are usually processes at work (the so-called genetic-automatic processes,) whereby one section of the population is multiplied while the remainder perishes and in this way any rare gene may assume a sudden importance. Its further fate depends on the effect which natural selection has upon it. As the result of continued mutation the assortment of genes remains high and as the result of this process the plasticity of the species, its power of adaptation, is retained. It is in this way that the innumerable ecogenotypes comprising a species are formed. When a sudden change of the above nature arises which is favoured by natural selection, the population may form a new centre of development of the species.
Mutation is thus the basal process of evolution and although it is independent of external conditions the fact that its products are influenced by selection gives these two processes a mutual relationship, the mutational processes of succeeding generations being determined by the effects of selection in the preceding ones. The influence is rarely exerted directly, but through the agency of the " genetic-automatic " factors, which determine the fate of a gene between the time of its origin by mutation and the direct action upon it of natural selection.
The " genetic-automatic processes " also frequently lead to the production of sharply distinguished ecogenotypes differing in characters of no adaptive value.
Thus Vavilov's law of homologous variation, which holds with regard to the mutational process, is shewn to be inapplicable to the species in general, owing to the disturbing influence of the medium and selection, together with the " genetic-automatic processes." At each stage of its evolution the species has several different lines upon which it is possible to carry on its further

evolution, it is in other words a complicated system in dynamic equilibrium. The course of evolution pursued is determined by the environmental medium.
Non-inheritable modification occurring in successive generations may also create local " ecomorphs " which differ in some characters produced by the action of the environment.
In view of the multiplicity of the processes influencing the evolution of a species only an insignificant part of its potential variety of characters is ever realized.

75. *Vavilov, N. I. 575.1:63.00.14(47)
(Genetics at the service of socialistic agriculture.)
Bull. Appl. Bot. Leningrad 1932 : Ser. A (4) : 19–42.
The new genetic and breeding work of the last few years in the Soviet Union is compared with that in the " capitalist countries," to the great disadvantage of the latter, and the schemes for the next Five Year Plan are outlined, first with reference to definite problems, then as regards the general principles involved. Great emphasis is laid on the linking up of breeding and genetic work, on the need for co-operation and systematization, and the necessity for having the whole diversity of existing forms rather than isolated fragments of a species available for breeding. This is illustrated by reference to immunity to disease, drought and cold, earliness (ideas on which have been revolutionized by Lyssenko's work on vernalization and the new discoveries in photoperiodism), chemical composition of the plant, fibre qualities, capacity to benefit from artificial manures, quantitative characters, etc. The inadequacy of present knowledge is emphasized and desirable lines of study are indicated.
Among the general problems under investigation that of distant hybridization is one of the most stressed. Various breeding problems whose main hope of solution lies in interspecific hybridization and a number of cases in which success has been attained on these lines are mentioned. Among the methods of achieving success are artificial chromosome duplication and triple hybridization by use of a third species having the same chromosome number as the sterile hybrid and with which the latter is compatible. The use of very large quantities is essential when applying the method of wide crosses and cytological study is indispensable. Still greater advances are expected from crosses of geographically separated races or species not differing in chromosome number, whereby wide variation and the appearance of a number of new characters and combinations of characters are attained without the attendant difficulties of sterility.
The problems of inbreeding, heterosis, artificial mutations, " Dauermodifikationen," chimaeras, the factors influencing sex and fertility and their control, the nature and behaviour of the gene and the origin of species and forms are pointed to as worthy of further study and application.

76. 575.113.4–18
Rasmusson, J. 575.172.1
A contribution to the theory of quantitative character inheritance.
Hereditas 1933 : 18 : 245–61.
As the result of long experience in applied genetics the Swedish geneticists have come to the conclusion that 100–200 genes are concerned in the inheritance of most quantitative characters. In opposition to the assumption that the factors act additively and independently the author quotes the failure to obtain homozygous types superior to the parents from crosses between highly improved parents and the frequent delay in the fall in yield to the second and later generations on inbreeding.
A new theory of quantitative factor inheritance is presented, where it is assumed that " the effect of each factor on the genotype is dependent upon all the other factors present, the visible effect of a certain factor being smaller the greater the number of factors acting in the same direction." The theory is referred to as the interaction theory.
The fact that genes do interfere one with the other is illustrated by the phenomenon of incomplete dominance, and the gradually falling degrees of effect of successive genes in a multiple factor series for qualitative factors, the latter phenomenon being quite plain even in Nilsson-Ehle's classical experiments on multiple colour factors in wheat.

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* An abridged translation of this paper is on file at the Bureau.

The effect is compared to the action of successive doses of a nutrient material on a plant and two possible systems for its expression are calculated, viz. a logarithmic function and a convergent geometric series, each giving various curves for varying degrees of interaction. The second system gave the more satisfactory curves.
By means of these curves it is shewn that the frequency distribution of homozygotes with different numbers of dominant factors in a late selfed population of a cross becomes more and more skew as the interaction increases. Moreover as the number of dominant non-segregating factors in a series increases, the genotypic variation due to segregation of a group of heterozygous factors diminishes, so explaining the difficulty of obtaining types better than two good related genotypes. An increase in the number of segregating factors enlarges the negative asymmetry of the genotypic segregation and so accounts for the number of inferior types in crosses between unrelated parents.
Similar curves are calculated illustrating the depression of a character determined by multiple factors in successive generations of inbreeding, for different degrees of interference. The same skewness accounts for the absence of depression in the first inbred generation and the calculated results agree very well with the observed in the case of the three colour factors in wheat grain.

77. FERGUSON, M. C. 575.114:519.24
To determine genetical ratios when selfing organisms heterozygous for 2 or more factors.
Amer. Nat. 1932 : **66** : 91–93.
A method of application of the expanded binomial for the calculation of the number and constitution of genotypes and phenotypes is described, whereby the process of calculation is facilitated.

78. PAWEL, M. 575.116.1:519.2
Algebraische Theorie zur Chromosomenüberkreuzung. Exakte Berechnung ihrer Wahrscheinlichkeit. (**Application of algebraic theory to crossing-over and the exact calculation of its probability.**)
Z. indukt. Abstamm.–u.–VererbLehre. 1933 : **65** : 141–46.
The author, who objects on mathematical and practical grounds to Morgan's use of percentages as a measurement of distances in crossing-over, has evolved a theory whereby the probability co-efficients for crossing-over, and for the corresponding separation of characters are treated as distinct from the true relative distances ; and a conversion formula has been derived for z and v where z = distance and v = probability of separation.
The advantages claimed are that exact figures are obtained instead of merely limiting values and also that x can be used like any other measure of distance in an exact calculation, which was not so in the case of Morgan's percentages.

79. EMERSON, R. A. and RHOADES, M. M. 575.116.12
Relation of chromatid crossing over to the upper limit of recombination percentages.
Amer. Nat. 1933 : **67** : 374–76.
The reason for the limit of recombination percentage lying at 50 is thought to be in the random crossing-over of the chromatids, since each point of cross-over produces 2 cross-over and 2 non-cross-over strands. A table is given shewing that the percentage of parental combination to recombination strands is 1 : 1, regardless of the relative frequency of single, double and other multiple cross-overs—i.e. independently of interference.

80. STERN, C. 575.116.12:576.354.4
Neuere Ergebnisse über die Genetik und Zytologie des Crossing over. (**Recent results in the genetics and cytology of crossing over**).
Proc. 6th Int. Cong. Genet. 1932 : **1** : 295–303.
In spite of the controversy which still rages as to the manner of crossing-over, investigators are agreed that the chromosomes regularly interchange portions during the reduction division, that

this presupposes a pairing of homologous chromosomes, that the chiasmata play an important role in the interchange and that the chromosomes are at the time of interchange already divided into two chromatids.

The series of experiments which led to the detection of the precise time at which crossing-over occurs is reviewed briefly and it is shewn how both the genetic and cytological evidence indicate that crossing-over takes place at gametogenesis, between 2 chromatids, and that it is dependent upon chromosome pairing, and that the extent of crossing-over roughly corresponds to the number of chiasmata. Crossing-over has now been cytologically demonstrated, on chromosomes both ends of which are morphologically recognizable, and in all cases observed there has been exact correspondence between the genetic crossing-over and the cytological crossing-over.

81. Sax, K. 575.116.12:576.354.46
The cytological mechanism for crossing over.
Proc. 6th Int. Cong. Genet. 1932 : 1 : 256–73.

The various genetic phenomena of crossing-over which any cytological theory is expected to explain are enumerated, together with the postulates of Belling and Darlington's theories of meiosis. Various objections to these are put forward, amongst which are the facts that haploid *Zea* chromosomes are split at early leptotene, and that little or no sister strand crossing-over, twisted strands or asymmetrical chiasmata have been observed.

According to the author's theory crossing-over occurs only when the chromatids break at a chiasma, chiasmata being caused by alternate opening out of sister and non-sister chromatids ; breakage only occurs when asymmetrical chiasmata are formed. The proportion of these is very small, except in certain organisms characterized by extreme frequency of crossing-over, a fact which is regarded as supporting McClung's rather than Janssens' theory of chiasmata. In support of his theory the author refers to the reduction in chiasma frequency, even in the *Zea*-teosinte chromosomes where no terminalization is possible and where the number is halved, not entirely cancelled ; the behaviour of unequal homologues, where the chromatids of equal length pair ; the greater frequency of proximal interlocking than of distal ; the occurrence of cross-overs in non-disjunction lines of Drosophila ; the pairing observed in chromosomes where no crossing-over takes place ; the frequency of chiasmata in *Vicia Faba* in comparison with the degree of crossing-over.

The author considers that chiasmata in the Drosophila male terminalize without breaking, possibly owing to the duration of meiosis which is different in male and female.

82. Nawaschin, M. 575.24
Altern der Samen als Ursache von Chromosomenmutationen. (**Aging of seed as the cause of chromosome mutations.**)
Planta (Berl.) 1933 : 20 : 233–43.

A full description of the investigation and results summarized in " Plant Breeding Abstracts," Vol. III, Abst. 552 (under Navashin). See also Abstract No. 1 above.

83. 575.243
Stadler, L. J. 575.24
On the genetic nature of induced mutations in plants.
Proc. 6th Int. Cong. Genet. 1932 : 1 : 274–94.

Segmental interchanges and other chromosome irregularities involving extremely small sections of the chromosome may often have the appearance of gene mutations.

The characteristic absence of dominant mutants in plants is caused by their lethal action in the homozygous state and thus on the haploid generation, the pollen and egg cell. The occurrence of dominant mutations has been demonstrated by irradiating the pollen. The ordinary simple non-lethal mutations have never been observed in maize and barley to revert to the dominant form.

Cytological studies of irradiated material indicate that translocations and terminal inversions do not occur, suggesting that the observed phenomena are simply the result of the attachment of broken portions to one another by their broken ends. Those fragments possessing a spindle attachment move to the poles and others are lost.

The degrees to which chromosome derangements and induced gene mutation are affected by such factors as temperature and even dormancy are approximately the same. Chromosome deficiencies for known genes have been obtained artificially, some being so small that the pollen developed almost normally ; two cases of apparently perfect pollen development were observed and it is suggested that the ordinary gene mutations in irradiated material may be of this type ; the fact that deficient endosperms have been known later to regain the deficient dominant characters is an indication that the deficient section is not always actually lost and that even reverse gene mutations may not be incapable of explanation on the same lines.
In polyploids deficiency is not always lethal, frequently not detectable or detectable in the form of a variation as in mutants of the speltoid type ; the loss of a segment containing a gene not duplicated in the other chromosomes simulates a recessive gene mutation. Similar effects may occur in non-polyploid species exhibiting gene duplication. Species of the *Andropogoneae* and *Maydeae* with five chromosomes are now known and it is possible therefore that maize is a polyploid species ; this may account for differences between the behaviour of maize and *Drosophila* and why homozygous translocations may be obtained in the former.
Of eight maize endosperm genes chosen at random all but one has mutated repeatedly during the last few years and all mutated independently of other even closely linked genes. In these genes however no perceptible increase in the mutation rate was observed as the result of X-ray treatment, although the 8th gene also mutated ; it is possible therefore that this is a gene susceptible to treatment, whereas the others seem to be definitely not susceptible, suggesting that natural mutations constitute a type qualitatively as well as quantitatively different from induced mutations.

84. JEFFREY, E. C. 575.252:576.356
Internal chromosomal variation and its probable cause.
Science 1933 : **78** : 34–35.
Attention is called to the frequency with which individuals or groups such as the orange and apple, known to be particularly prone to vegetative mutation, display irregularities at meiosis, usually owing to their being interspecific hybrids. It is suggested that the two phenomena are related.

EVOLUTION 576.12

85. DUBININ, N. P. 576.12
(Genetic-automatic processes and their significance in the mechanism of organized evolution.)
J. Biol. Exptl. Moscow 1931 : **7** : 463–79.
It has been shewn by various authors that wild populations are frequently heterozygous for recessive mutants. These mutations, as is now known, take place at random and independently of the medium in which the organism lives.
A change of external conditions may result in the emergence of a given character, hitherto valueless, and its spread through the entire species, if in the new conditions it proves to be of positive selection value.
As soon as selection is discontinued, evolution ceases—random mutation continues without any directional influence and this produces an immense variety of characters, as in the case of domestic animals and plants and man.
Chetverikov has emphasized the importance of isolation, which he regards as a more important factor even than selection in differentiation of species, since otherwise the whole population is involved in the mutational changes. By isolation of a portion of the species hybridization with the rest is excluded and evolution on independent lines is made possible.
It is shewn that a single mutant in the course of generations again disappears and thus for new mutants which have not reached a certain concentration the principle of " levelling hybridization" still holds. Since all mutant genes are in this class to begin with they are all doomed to die out ; single mutants are retained only by special, so-called " genetic-automatic processes," whereby some biological peculiarity disturbs the proportions of the progeny—e.g. if in a certain population

only a very limited section survives to produce the succeeding generation and if this section contained a mutant, this mutant would be perpetuated in sufficient quantity for the ordinary laws of population to hold. In colonial forms of multiplication also there may occur a chance concentration in a similar way, of genes, independent of the evolutionary value of these genes ; also in cases of depression and sudden flourishing of species, etc., etc.

In general, the biology of the species therefore exercises an important influence on the process of evolution. Any influence which affects the dynamic equilibrium which exists within a population may have far-reaching effects and many populations have suffered almost complete annihilation, followed by the restoration of the new population from the minute section which survived. This may entirely remove certain mutant genes.

Thus a species is not to be regarded as a population in which chance mutants gradually accumulate in measure corresponding to the age ; the concentration of genes of a given population is rather determined by the " mutual relationships existing between the populations and the medium in which are included the mutation process and the history of the population in the immediate past." Again, the species consists not of uniformly distributed genes but of sections—ecogenotypes—differing very markedly one from the other in their genic make-up.

The very existence of recessive genes of no or negative selection value in the population further shews that the increase in concentration of mutant genes in a population is not the result of selection acting on the heterozygotes. The genetic-automatic processes can in fact act in spite of natural selection and lead to the concentration of a gene which is actually prejudicial to the organism, followed by a gradual decline of the gene as a result of selection. In the case of a useful gene the process is assisted by selection.

Thus the evolutionary transformation of the species is visualized not as a uniform and gradual response of the species as a whole but as a sudden transformation of an individual ecogenotype. This changed ecogenotype becomes the source of evolution of the whole species. Of such sources more than one may occur, from which new better adapted forms extend. For this reason the geographical distribution of genes is not a reliable indication of the history of a species, especially an animal species.

All the evolutionary processes are mutually interconnected and selection has an influence on the mutational process itself. Nevertheless the individual processes are distinct and each is governed by its own set of laws—the mutational process, the genetic-automatic processes, the form and laws of the population, the laws of the evolutionary change of organized forms.

86. FISHER, R. A. 576.12:575.1

The evolutionary modification of genetic phenomena.

Proc. 6th Int. Cong. Genet. 1932 : **1** : 165–73.

If in a population containing a rather considerable number of individuals heterozygous for a deleterious gene a modifier is present which tends to obscure the action of this gene and so make the heterozygotes normal the modifier will in the course of evolution be selected and the gene in question become entirely recessive in effect. If the homozygote is viable a further stage then sets in whereby the effect of the homozygous gene is modified, culminating in its entire suppression. Grounds are given for supposing that the process has in nature usually been brought about by a group of modifiers. The theory is supported by reference to a number of cases where advantageous genes are dominant, where mutant genes have proved to be incompletely dominant in genetic media in which they do not normally occur, etc. In the case of multiple allelomorphs the modifiers of one relatively viable member of the series affect also less viable members which themselves could not have survived.

87. HALDANE, J. B. S. 576.12:575.1

Can evolution be explained in terms of known genetical facts ?

Proc. 6th Int. Cong. Genet. 1932 : **1** : 185–89.

The palæontologist has repeatedly given proofs of continuous evolution, the systematist of discontinuous evolution.

Many species, even some of those giving sterile hybrids, differ in a comparatively small number of clear-cut genes, others in chromosomal differences which can be produced experimentally within

the species and all phenomena associated with species crosses have been observed in variety crosses with the exception of death of all the F_1 hybrids.
Calculation shews that natural selection would produce changes rapid enough to account for evolution as recorded in the rocks, though the possibilities of gene recombination are so enormous that the chances of getting the most favourable combination are very low.
The evolution of certain characters indifferent to selection results from their association with others having a selection value.
Intense competition between members of the same species may lead to the establishment of a race less fit in all characters but those making for rapid initial multiplication.
In characters without selection value mutation plays the chief part.
A dominant species in a fairly stable environment is subject to evolution by the very gradual spread of genes, a small isolated species may evolve by much more sudden steps resulting from cytological or other changes.
There is no reason to suppose that the whole evolutionary process will not ultimately receive genetic explanation.

CYTOLOGY 576.3

88. LEVITSKY, G. A. 576.312:575
(The cytological method in plant breeding.)
Bull. Appl. Bot. Leningrad 1933 : Ser. A (5–6) : 30–47.

After a brief discussion on the nature of the cell constituents the author refers to the decisive role played by karyology in the systematics of the wheat species, and the occurrence of parallel polyploid series also in a number of other genera ; it is pointed out however that differences in chromosome number are frequently found in quite small systematic units and by no means correspond to specific differences. Thus it is of great importance to choose races with appropriate chromosome numbers before making a cross.
Differences in chromosome number of a non-polyploid nature usually correspond to larger systematic units. However, by the author's special method of fixation, clear differences in form and size of the chromosomes have been demonstrated between species or races not differing in chromosome number.
The first differences of this kind to be reported were in *Vicia angustifolia* and *V. Cracca*, consisting in the relative size of the chromosomes and of their arms in the former species, and in an apparent fragmentation of one chromosome into two in the latter. The chromosomal differences between the races were accompanied by morphological and agronomic differences. Similar differences have recently been observed in the opium poppy.
The study of these chromosome characters makes it possible to establish the relationship between groups of forms or of species and thus elucidate their origin, as has already been done in *Aegilops*, where the chromosome complement of one tetraploid species has been shewn to consist of the diploid complements of two other known species (see " Plant Breeding Abstracts," Vol. III, Abst. 393).
Although in interracial crosses pairing is usually complete, differences occur and may be inherited on Mendelian lines, accompanied by differences of the genotype. Meiotic disturbances may occur in racial crosses just as in species crosses, especially in crosses of geographically separated races. Certain races, moreover, contain genes conditioning irregular meiosis. On the other hand meiosis in crosses of nearly allied species of the same chromosome number may often be perfectly regular.
Meiotic irregularities have been shewn to be influenced by external conditions, a point of importance in connexion with partially sterile interspecific hybrids, etc.
In the artificial production of polyploidy, the method of Jorgensen is receiving extensive study at the Institute of Plant Industry ; polyploid cabbages have already been produced and the importance of this and other means by which polyploidy can arise is indicated with reference to the production of fertile amphidiploids from sterile hybrids, a number of cases of this being discussed. Reference is also made to a new wheat-rye hybrid obtained by Lebedev ; an unreduced egg of the F_1, having been fertilized by rye pollen, gave an individual with 35 chromosomes. Autosyndesis occurred, which, followed by loss of the univalents, has led to the production of various constant hybrids with 28 chromosomes.

By X-ray treatment all kinds of alterations of the chromosomes can be induced and by subsequent self-pollination obtained in homozygous condition. Balanced forms may thus be produced which in spite of their changed chromosome constitution are morphologically indistinguishable from the normal. Various chromosome irregularities and the associated genetical phenomena are discussed.

89. 576.351.5:575.129
MÜNTZING, A. 575.127:581.162.5
Hybrid incompatibility and the origin of polyploidy.
Hereditas 1933 : **18** : 33–55.

A discussion of various views on the nature of the incompatibility which almost invariably exists between forms differing in chromosome number, whether spontaneous or artificially produced, is presented, in which emphasis is laid on the identical behaviour of auto- and allo-polyploids. The incompatibility is evidently due therefore to a quantitative rather than a qualitative difference. The influence also of the chromosome number of the somatic tissues of the maternal plant is shewn by the viability of an unreduced egg of a diploid, as compared with the sterility of the normal egg of the corresponding auto-tetraploid, which nevertheless has the same chromosome number, when fertilized by haploid pollen.

The preponderance of tetraploids produced by many tetraploid x triploid or diploid crosses is ascribed to the greater viability of the tetraploid zygotes arising from fertilization by an unreduced gamete and in cases of a similar kind, many of which are quoted, the results are thought to be due to zygotic selection rather than to pollen tube competition. The most viable zygotes and the best seeds come from the union of gametes with equal chromosome numbers. The changed relationships between chromatic content of embryo, endosperm and somatic tissues is thought to explain the results of Kihara and Nishiyama in oat crossing (see " Plant Breeding Abstracts," Vol. III, Abst. 204) rather than the stimulative action of the male nucleus assumed by these authors ; in support of this it is pointed out that in the cross 6n x 2n the development of both embryo and endosperm are arrested.

The author shews how if a newly arisen tetraploid can cross with the diploid population the chances of its perpetuation are very low. If on the other hand it is incompatible, these chances are enormously increased and the many polyploid species in nature are thought to have arisen and been preserved in this way. It is pointed out that the existence of these peculiar relationships between seed, endosperm and somatic tissue is a result of the process of double fertilization whereby the endosperm is formed and it is suggested that the frequency of polyploidy in most groups of the Angiosperms is a result of this condition. The argument is supported by reference to other groups such as the orchids, the lower plants and the animals, where double fertilization does not occur and in which polyploid species are conspicuously lacking and the interspecific fertility is unusually high.

90. FEDERLEY, H. 576.354.46
The conjugation of the chromosomes.
Proc. 6th Int. Cong. Genet. 1932 : **1** : 153–64.

Chromosome pairing, whatever may be its ultimate cause, is known to be influenced by the structure of the chromosomes, the genotype of the individual and the environmental conditions of the cell and the individual. One essential for conjugation is homology of the chromomeres along the length of the chromosome and where translocations have occurred chiasmata fail to be formed. That homology is not the only factor is illustrated amongst other things by the irregular conjugation in many amphidiploids and that a polyploid species sometimes gives autosyndesis when crossed with one species and complete absence of it when crossed with another. The danger of drawing taxonomic deductions from chromosome pairing is evident from such results. Meiosis may be quite different in the pollen and embryo sac mother cells.

With regard to the external influences, conjugation seems to be particularly susceptible to the influence of temperature.

Finally, various cases of definite genes influencing conjugation are quoted.

91. Bleier, H. 576.354.5
Die Störungserscheinungen in den Reifungsteilungen und die Entstehung orthoploider Gonen bei Haplodiplonten. **(The irregularities in the maturation division and the origin of orthoploid gametes in haplodiplonts).**
Züchter 1933 : **5** : 159–68.

Organisms which in the diploid phase possess only the haploid chromosome number (haplodiplonts), though not rare in animals, are in plants only known as exceptions. They resemble the normal diploids except in the reduced size of the cells and of the whole plant and in the irregular reduction division, the degree of which depends on the number of gemini formed, just as in inter-specific hybrids, and which in autopolyploids may be entirely absent.
Following the cases of haplodiplonts in animals, various types of haplodiplonts in plants are described, these being (1) the *Datura* type with the haploid chromosome number, no pairing, or only very exceptional cases, occurring at metaphase and the chromosomes, or their halves when splitting occurs, being distributed at random to the poles ; (2) the *Nicotiana* type, allopolyploids, in behaviour similar to the haploids : the formation of restitution nuclei in these types can, according to the previous behaviour of the chromosomes, lead to varying results, including gametes with the diploid and even tetraploid chromosome number ; these may occasionally result also from a repeated splitting of the chromosomes, (3) the *Oenothera* type, derived from autotetraploids and therefore possessed of the diploid chromosome number, and displaying regular meiosis, (4) the *Solanum* type, triploid, derived from a hexaploid individual, two chromosome sets, being homologous, form gemini, leaving the rest unpaired.
The correspondence between these types and the different types of hybrids is pointed out ; nearly all types produce a certain proportion of gametes with reduced, somatic and double-somatic chromosome numbers.

92. Matsuda, H. 576.356.5:575.12
(Crossing between gametes with different numbers of chromosomes, in petunias.)
Jap. J. Genet. 1933 : **8** : 261–63.

The F_1 from a tetraploid x diploid cross contained a large number of triploids of intermediate type, a few heteroploids, a few diploids (of which the possible modes of origin are discussed) and one tetraploid due to apogamy in the tetraploid parent.
Diploid x tetraploid crosses gave either plants like triploids though actually tetraploids in constitution in some instances, or else diploid plants like the ♀ parent and arising by apogamy. In tests with polyploid pollen on diploid plants only diploids resulted. Parthenogenesis in the diploid is the suggested explanation, polyploid pollen being regarded as incapable of selfing.

BOTANY 581

93. 581.1(063)(47)
(Systematic planning of agro-physiological research in U.S.S.R.)
Bull. Appl. Bot. Leningrad 1933 : Ser. A (5–6) : 3–29.

Account of Conference, containing reference to a number of addresses on resistance to drought, soil salts and cold, the general study, with special reference to the production of resistant forms. The central theme of the conference was the utilization of the long northern day, of which the most outstanding is said by Maximov, in his address, to be Lyssenko's method of vernalization, an outline of which follows, based on Lyssenko's address. On extending the work to cotton, maize, millet and soya bean the principles established for cereals have been shewn to apply also to other plants. Cotton for instance requires " high temperature, together with certain other factors," which can be successfully applied before sowing ; the other plants require darkness. Vavilov in his address points out how important it is that breeders should take these new views into consideration. The resolutions passed by the conference are given.

94. McKinney, H. H. and Sando, W. J. 581.143.26.03
Russian methods for accelerating sexual reproduction in Wheat.
J. Hered. 1933 : **24** : 165–66.
A short description of work on the vernalization of certain cereals already noted in " Plant Breeding Abstracts," Vol. III, Abst. 554.

95. King, G. E. and Burrell, A. B. 581.162.3:578.08
An improved device to facilitate pollen distribution by bees.
Proc. Amer. Soc. Hort. Sci. 1932 : **29** : 156–59.
A description with diagrams and a report of tests of an improved pollen disperser whereby prepared pollen is made accessible to honey bees in order that it may be carried by them during their normal foraging flights and thus effect pollination of apple blossoms. An increased yield was obtained.

AGRICULTURE 63

96. *Kovalev, N. V. 63.00.15(47)
(The Institute of Plant Industry on the 15th anniversary of the October revolution).
Bull. Appl. Bot. Leningrad 1932 : Ser. A (4) : 3–18.
An outline of the work of the Institute of Plant Industry and its various sections : the section of plant resources and initial breeding material, whose object is to mobilize the plant resources of the whole world and make them available to Soviet breeders, and even for direct introduction into cultivation in certain cases ; the section of variety testing and seed production, whose object is to determine the varieties most suitable for each district and introduce them to the exclusion of all others ; the section of breeding technique, whose task it is to direct and organize the operation of the innumerable breeding institutions working under its charge, on different crops and in different ecological regions of the Soviet Union ; this section also includes special laboratories for cytology, anatomy, etc., and new breeding methods have been evolved making use of wide crosses, induced polyploidy, inbreeding cross-pollinated plants, etc. ; the section of biochemistry and physiology, studying resistance to drought, cold etc., and the regulation of the vegetative period, and the determination of the content of various organic materials in the different varieties, mainly by microchemical methods.
The extension of cultivation into regions hitherto uncultivated is one of the major objects of the Institute, which accounts for the emphasis placed on earliness and resistance to drought, cold and various diseases ; the training of workers and publication of the results also form part of its activities.

FIELD TESTS 631.421

97. Ducomet, V. 631.421:519.24
Essais comparatifs de rendement—Simplification dans le calcul des erreurs et méthode simple d'interprétation des résultats d'après la comparaison des produits parcellaires. (**Simplification in calculation of error and a simple method of interpretation of results by comparison of plot products.**)
Sélectionneur Français 1932 : **1** : 22–44.
Methods are explained for simplifying the calculation of the errors of yield trials by using the mean error in place of the root mean square error, and by providing tables for the purely numerical factors involved. It is not considered that an elaborate use of the theory of probability is needful for the calculation of odds, and a method is proposed, applicable to the comparison of two varieties, or in general to any number with interspersed controls, which depends on taking arbitrary limits for the range of variation of the relative yields of the replicate plots. A mathematical justification for the proposed method is not given.

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* An abridged translation of this paper is on file at the Bureau.

98. *Flaksberger, C. A. 631.524(47)
(The plant resources of the world in the Soviet Union).
Bull. Appl. Bot. Leningrad 1932 : Ser. A (4) : 43–56.

A brief outline is given of the early activities of the Institute of Plant Industry, leading to the expedition which established the centres of diversity of the main agricultural plant species. The main centres, and the crops which they embrace, are enumerated, and also the places to which expeditions have been sent.

These studies have given the real indication of where to draw the most suitable material to replace and improve the present crops, and to introduce new crops such as rubber plants, essential oil plants, new fibre, oil and protein-bearing plants and new fodder plants. The material was collected by means of letters of request, personal conversations, exchange of material and by expeditions. The collections made in this way are in the live state and so serve as a store of material, embracing over 200 crops and a total of over 150,000 specimens.

The extreme ecological specialization of wheat makes it essential to develop local forms. Some of the wheats produced by the author from the local material are first rate in nearly all characters, with the exception of certain ones such as resistance to lodging, shedding, fungous attack, etc. and earliness, yield. These defects are being remedied by crossing them with the appropriate lines from among the world collection, this has already been achieved to a notable extent in crosses of Novinka with the Scandinavian wheats. The world collection contains not only innumerable new varieties and strains but several hitherto unknown species.

Vernalization tests on the whole world collection of wheats are in progress.

Barley is less polymorphic and more plastic than wheat and stands introduction more successfully. Many types occurring in the world collection have been introduced direct. The collections of oats have revealed forms of *A. byzantina* capable of growing through the mild winters of Transcaucasia and so giving very high yields. They are resistant to many unfavourable conditions and are valuable for direct introduction in the south and for breeding in the north.

Collections on similar lines have been made of rye, maize (containing early forms ripening in 70 days), potato and may other crops, both those already cultivated and others of interest for introduction into cultivation. An invaluable fund of breeding material has in this way been created. Only after a thorough investigation can this material be put to full use. Hybridization between different genera, species and geographical races and the production of constant fertile hybrids are regarded as a particularly promising field of development.

99. *Maleyev, V. P. 631.525
(Theoretical basis of plant acclimatization.)
Suppl. 60. Bull. Appl. Bot. Leningrad 1933 : Pp. 168.

The combination of systematics and genetics which has been made to solve the origin of species and forms and their geographical importance, is also of major importance from the point of view of acclimatization, since these studies deal with the very material on which acclimatization is to work. The new ecological systematics shew the connexion between the distribution of plant groups and the ecological conditions of the environment, such studies being fundamental to the problem of introduction and acclimatization. Modern Soviet studies on acclimatization take into account the internal composition of the species and the reaction of the species and its component parts to environmental influences, which latter govern not only its geographical distribution but also its capacity for acclimatization in general and in any particular country. These and many general questions connected with the problem of acclimatization are discussed at great length. Emphasis is laid on the ever increasing realization of the complexity of the species, together with its restriction to a particular area, the units with which present-day systematics deal being real ecological (i.e. physiological) units. The nature of the various systematic units and of their geographical distribution is discussed at considerable length. This discussion makes amply clear the importance of a knowledge of the nature of the area of a species—e.g. whether expanding or contracting—in all questions of acclimatization. The area of a species may be limited by historical, impedimental and many other factors other than climatic, in which case the species may be capable of artificial introduction into regions far beyond its present area.

* An abridged translation of these papers is on file at the Bureau.

The various factors influencing acclimatization are reviewed in some detail.
A clear distinction is drawn between the acclimatization of a species and that of an individual. The capacity of a species for acclimatization, i.e. its plasticity, depends largely on the number of distinct ecological types (ecotypes and biotypes) it contains, i.e. on its genotypic variability or differentiation. The potential variability of most species is much greater than is apparent, and the full expression of this can only be brought out by breeding, by which recessive forms can be unmasked, and this is the best method of acclimatization, except in plants where such a process takes too long, in which case large populations of material from regions with a climate as nearly as possible similar to that of the country of introduction should be sown and the most successful selected. The existence of climatypes in many forest trees is demonstrated. Hybridization with allied species will often increase variation and so the chance of obtaining the desired types. Parallel with the modifications of the species brought about by a given climate, there is often a modification of the individual in the same direction. This is not hereditary and is of less importance.

PLANT DISEASES 632

100. BRENTZEL, W. E. 632.451.3:576.16:633.11
Physiologic specialization of *Tilletia tritici* on emmer.
Phytopathology 1933 : **23** : 483–85. (Abst.)
Infection of *Triticum dicoccum* by *Tilletia tritici* has become much more common recently. Clear morphological differences were observed between the spores from four different emmers and 146 different *durums*. The smut balls developing from them on Ceres wheat were different and also their pathogeneity, the emmer smuts attacking Yaroslav emmer more than common wheats, the *durum* ones vice versa. Up to the present the 4 emmer smuts appear to be identical.

101. MATSUURA, I. 632.48:575.242
[Experimental studies on the saltation in fungi. (Preliminary report). VII. On the mechanism of the occurrence of " island " type of saltation.]
J. Plant Prot. 1932 : **19** : 409–28.
In *Helminthosporium* the " island " type of saltation was observed to be preceded by a sinking of the mycelial strands under a liquid secreted from their under-surface ; and the saltation is attributed to the action of certain metabolic products produced by the fungus and contained in this liquid.

102. PAXTON, G. E. 632.484:575.24
Consistent mutation of *Helminthosporium sativum* on a no-nitrogen medium.
Phytopathology 1933 : **23** : 617–19.
Cultures grown on Czapek's medium without the sodium nitrate invariably formed sectors much more abundantly, and of a different type, from those occasionally occurring on the normal medium. No sectors were formed if sucrose was also omitted.

103. MATSUURA, I. 632.484:575.242
[Experimental studies on the saltation in fungi VI. (Preliminary report). On the saltation in the genus *Brachysporium*.]
J. Plant Prot. 1932 : **19** : 121–39.
In various races of *Brachysporium* parasitic on *Setaria italica*, red pepper and other plants, a saltation characterized by white patches of mycelia appeared and persisted through several generations except in a few instances of reversion to type. Incidentally the pathogeneity of *Brachysporium* from *Cynodon Dactylon* was found to be stronger towards *Cynodon* and weaker towards rice than was the case in the original race.

104. *Kočnar, K. 633:575(43.7)
Zpráva o činnosti šlechtitelské sekce Zemského výzkumného ústavu zemědělského v Brně za rok 1930. (**Report of the work of the section for breeding for plant improvement at the Provincial Agriculture Research Institute at Brünn for the year 1930**).
Publikace Šlechtitelské Sekce Prague 1931 : **41** : Pp. 14.

A progress report on the variety and yield tests of selected strains of rye, oats, wheat, barley, lentils, potatoes, onions, garlic, lettuce, kohl-rabi, carrots, parsley and asparagus. In most cases local varieties have been used as the initial breeding material. Final results are not yet available.

105. Vavilov, N. I. 633:576.16
The process of evolution in cultivated plants.
Proc. 6th Int. Cong. Genet. 1932 : **1** : 331–42.

Some regions of the world are extraordinarily rich in species whilst others are remarkably poor. In the Caucasus and Turkestan, where wild fruit trees abound, it is possible to trace the process of evolution from the wild to the cultivated state. Similar studies have been made on the crop plants of other countries by means of expeditions and 300 different species are now under investigation. The material so collected, distributed to the appropriate climatic zones of the Soviet Union forms the initial material for the plant breeder.

The studies have led to the view that the Linnean species is a mobile and complex system, bound in its genesis to a definite area. The fundamental item from the point of view of breeding and genetics is a knowledge of the distribution of the genes within this area and a study of this has revealed quite unexpected riches of genes in certain limited sections of the areas of well-known species such as wheat, potato, etc., together with a number of new, hitherto unknown species. Such regions are the centres of origin of the species in question and so far 7 such centres have been distinguished, embracing nearly all cultivated plant species. They correspond to the sites of the first agricultural civilizations.

Thousands of cases of parallel variation of the characters of allied species or genera have been observed, the missing types often having been found in the centres of origin.

The centres are characterized by the presence of dominant genes and many dominant characters elsewhere unknown have been there revealed. On withdrawing from the centres the proportion of dominant genes gradually diminishes, illustrating the trend of evolution. Secondary dominant mutants, existing only in cultivation, occasionally appear in peripheral regions of the area. A further feature of great breeding value, associated with the forms from the primary centres, is their possession of the combined characteristics of several species.

The dimensions of the seeds, fruits and flowers shew a general increase on passing from the Himalayas towards the Mediterranean. Other regions are characterized by the presence of definite types in a number of different species and genera, such as naked cereals in East Asia, tuberous plants in Peru and Bolivia, etc., and all regions have evolved their own special ecological type. The role of natural selection is great and has even transformed former weeds into independent valuable crops. In certain ancient civilizations conscious human selection has also been a factor of considerable importance.

The scope of genetic and breeding work has been tremendously enlarged by the control of the reproductive phases made possible by Lyssenko's method of vernalization.

A genetic study of the gigantism witnessed in the evolution of so many crop plants is urgently required. In fact the whole study of their evolution from the point of view of genetics, the influence of hybridization, mutation, inbreeding, etc., is only now beginning ; in particular, to hybridization between different species, genera or geographical races must be ascribed a vast role in the origin of new crops both in the past and the future.

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* A full translation of this paper is on file at the Bureau.

106. Appel, O. 633–2–1.521.6:575
Die Züchtung krankheitswiderstandsfähiger Sorten. (**The breeding of varieties resistant to disease.**)
Mitt. deuts. LandwGes. 1933 : **48** : 304–05.
Examples are given of the breeding of forms of various crops resistant or immune to a number of different diseases or unfavourable influences, including the production by many private breeders of wart-resistant potatoes. It is pointed out that this would not have been possible but for the improved methods of testing evolved by various scientists.
The difficulties of the problem when dealing with sexually reproduced plants, especially cross-pollinators, or when resistance can only be obtained through a wild species or genus are considerably greater. The use of the latter method is illustrated by phytophthora resistance in potatoes and phylloxera in vines. The author states emphatically that the appearance of a new form of phytophthora capable of attacking the hitherto immune varieties does not vitiate the work, since it is not yet known how prevalent this form is and moreover, potato forms are now available which are resistant even to the new phytophthora strain. The difficulties and possibilities of breeding for resistance illustrated by these two plants are more or less typical for the majority of other crops.

107. Gassner, (G.) 633–2.111–1.521.6:578.081
Methodik der Prüfung auf Winterfestigkeit bei Getreide und Nutzanwendung der Ergebnisse für die praktische Pflanzenzüchtung. (**Technique of testing winterhardiness in cereals and the application of the results in practical plant breeding.**)
Mitt. deuts. LandwGes. 1932 : **44** :
A new laboratory method of determining winterhardiness by artificial freezing has been evolved which, it is claimed, avoids the difficulties inherent in the refractometric method. The new method is easily applied and has given reliable results. The plants for testing are subjected to artificial freezing under laboratory conditions resembling as closely as possible natural environment ; the artificial freezing tests are therefore made only in winter and other factors such as age of plant, available soil nutrition, etc. are fully considered in making the test. Full details of the planting and freezing processes are given. Reliability is ensured by repetition of the frost resistance test several times during the winter and confirmatory evidence is derived from annual comparative cultural experimental plot tests with large numbers of varieties and strains.

108. Honecker, L. 633–2.4–1.521:575
Aktuelle Probleme zur Bekämpfung von Pflanzenkrankheiten durch Züchtung unter besonderer Berücksichtigung des Getreides. (**Present-day problems in the control of plant diseases by breeding with special regard to cereals.**)
Landw. Jb. Bayern 1933 : **23** : 403–18.
In this article the author states the present position with regard to the relation of genetical study to resistance to parasitic fungi in wheat, oats, barley and potatoes with special reference to the German varieties.

109. 633–2.4–1.521.6
Schmidt, M. 633–2.4–1.521.6:575
Über die inneren Ursachen der Widerstandsfähigkeit von Pflanzen gegen parasitische Pilze. (Sammelreferat.) [**On the internal causes of resistance of plants to parasitic fungi. (Review of literature.)**]
Züchter 1933 : **5** : 132–41.
In this survey of the literature genotypic resistance is regarded from two aspects (a) passive resistance which may be based upon a morphological or a physiological defence reaction only taking place in infection and intimately related to the biological activity of the host and (b) active resistance which may have a morphological, histological, physiological or chemical basis. As examples of (a) there is the resistance due to phenotypic characters, e.g. habit, or rate of

development, by which even susceptible early varieties of potatoes, cereals, etc. may escape infection. Among the morphological resistance factors are structure of the epidermis (thickness, etc.), the cuticle, the stomata, etc. Of the chemical factors that may perhaps condition resistance the osmotic pressure and H-ion concentration of the sap are discussed; but the difficulties of investigation are mentioned. Certain chemical substances in the cell such as tannins and alkaloids, carbohydrates and proteins have been regarded by some as taking part in resistance reactions, but a review of individual work shews that our knowledge of the factors of passive protection of plants against fungi is very slight and this is even more true of the phenomenon of active resistance which is discussed in relation to traumatic hormone production in vines and the anatomical changes occurring in flax attacked by *Fusarium lini*. The problem of physiological specialization is briefly considered. As far as is known active resistance consists mainly in the production of some protective substances in response to toxic or other stimuli of parasites. One instance of acquired immunity of plants to a fungus disease is cited, but the whole problem of immunity is still an unsolved problem.

Little is known of how far linkage or other correlations may exist between genes for resistance and for other characters, especially morphological. Rieman has, however, demonstrated the genetical relationship between colour of onion scales and resistance to *Colletotrichum circinans* (cf. " Plant Breeding Abstracts," Vol. I, Abst. 593).

110. *Kovalev, N. V. 633.00.15(47)

(The practical achievements of the Institute of Plant Industry in 1931.)

Bull. Appl. Bot. Leningrad 1932: Ser. A (4): 169–202.

In order that the achievements of the Institute of Plant Industry should be made known as rapidly as possible to the public, a short collective review, written by workers in the respective sections of the Institute, is given of various practical achievements terminated in 1931.

World collections of nearly every crop have been made and studied. In wheat, specimens best illustrating the ecological type of each country have been selected from amongst 5,000 specimens sown annually. None of these are suitable for immediate introduction and the most appropriate are to be used for crossing with the best local wheats. The whole collection is also being tested after vernalization.

Very resistant forms of *Avena byzantina*, and particularly forms suitable for winter sowing, are being used, and drought resistant Mediterranean oats have already yielded superior drought resistant early forms immune to disease by crossing with White Tartar.

Various geographical groups of barley, each containing certain valuable characters, have been distinguished.

Very early forms of maize, some suitable for mechanized farming, have been isolated, others which remain green up to harvest, and many other interesting forms of sweet, dent and starchy maize, together with an excellent sorghum for arid regions.

Interesting forms of fruit trees and vegetables have also been found amongst the collections, some of the former constituting new species hitherto unknown and possessed of a number of excellent qualities, including resistance to various unfavourable factors and agencies, e.g. an Afghan almond equal to the pistachio in drought resistance, a species of *Crataegus* extremely resistant to both drought and frost, a hermaphrodite *Fragaria*, etc.

An outline is given of the new breeding programme based on the utilization of these interesting forms and the knowledge now gained as to the geographical localization of all the characters of economic value. A study has been started on the variation and inheritance of the chief components of yield and the combination of yield with earliness. These have shewn that parents of the same degree of earliness may give very different results with regard to the practical success of the early segregates.

Attention has been devoted to methods of breeding flax, with the production of non-lodging forms, etc., rye with the production of short-strawed leafy forms, forms resistant to mildew, etc. by inbreeding, swedes and other roots, hemp, grasses, field peas, and potatoes by the use of South American species resistant to frost and phytophthora and possessing suitable chromosome

* An abridged translation of this paper is on file at the Bureau.

number. Use is being made of the transgressive segregation observed in crosses of geographically widely separated races and of artificially produced polyploids for extending the range of possible crossing.
Some of the most outstanding new cereal varieties produced are briefly described and also the methods of testing quality of flour, fibre, various chemicals, alkaloids, fats, etc., and resistance to various factors, in many cases so facilitating the work that many hundreds of estimations can be made daily, are described. In this way it has been possible to produce alkaloid-free lupins, the method of vernalization has been improved, flowering has been controlled, cold resistance augmented by adjustment of length of day and charts shewing the limits of possible cultivation of the various crops in the U.S.S.R. have been constructed.

111. 633.00.15(47)
*Zhukovsky, P. M. 631.524(47)
(The principal changes introduced by the Revolution into the diversity of the cultivated plants.)
Bull. Appl. Bot. Leningrad 1932 : Ser. A (4) : 57–66.
The introduction of new early-maturing Egyptian varieties, new methods of accelerating ripening and the opening up of new regions highly suitable to cotton cultivation, and the discovery of a method of vegetative reproduction whereby high-yielding though sterile F_1 hybrids can be cultivated, have all contributed to the recent success of cotton production. Various new plant species are under trial for use as fibre, oil, rubber, aromatic, medicinal, sugar plants, stimulants, etc., in addition to new varieties of fruit trees and vegetables.
The breeding of new types also of the common crops has been made necessary by the change in agricultural methods.

CEREALS 633.1

112. 633.1:575.127
Tschermak, E. 633:575.127
Über einige bei reziproker Kreuzung nur selten gelingende Bastarde. **(On some rarely successful reciprocal crosses.)**
Züchter 1933 : 5 : 123–28.
Among the rare hybrids described is the rye x wheat hybrid which morphologically and cytologically resembles the more common wheat x rye cross. The author's new specimen which is described in detail was obtained from a winter rye (Sturm R. x Tschermak R.) x F_3 (F_2 Bochara–Wheat x Buhlendorfer Winter rye) cross, but proved almost completely sterile even in the back-crosses. He has also made successful crosses with *Triticum monococcum*, all forms of the emmer and *Triticum vulgare* groups, and cultivated rye and also a number with *Secale montanum*, though the cross *T. villosum* x *S. cereale* has not yet been made.
The reciprocal cross of *Aegilops ovata* x *T. vulgare* can be obtained, though with difficulty, and the self-sterile F_1 set seed in back-crosses with either parent. Fertile non-segregating *Aegilotricum* hybrids were obtained from *Aegilops ovata* x *T. durum* var. *Arraseita*, *Ae. ovata* x *T. dicoccoides*, *Ae. ovata* x *T. turgidum compositum*, *Ae. ovata* x *T. dicoccum*. *Aegilops*-rye (*Aegilocale*) hybrids have not been obtained reciprocally. The hybrids *Ae. ovata* and also *Aegilotricum* crossed by rye are completely sterile and do not produce seed on back-crossing. According to Tschermak Benes' so-called *Aegilops ovata* x *Secale cereale* (*Aegilocale*) hybrid is actually a spontaneous cross of *Aegilotricum* with a wheat hybrid (i.e. *Aegiloditricum*) and resembles Tschermak's fertile *Aegilotricum* hybrids in type and in its segregation. Though Tschermak himself has obtained the *Ae. ovata* x rye (*Aegilocale*) hybrid the reciprocal is very difficult to produce. *T. vulgare* x *T. villosum* gives a constant hybrid *T. turgidovillosum* and the reciprocal should soon be obtained. *Phaseolus multiflorus* x *P. vulgaris* though rare was obtained by using short, white flowered runner beans extracted from a cross between a short, white flowered *Phaseolus* and a white runner and its morphology and mode of pollination and fertility are described ; the question of resistance to *Colletotrichum lindemuthianum* is mentioned.

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* An abridged translation of this paper is on file at the Bureau.

The author's repeated attempt to obtain a lentil-vétch hybrid having failed he is very sceptical about this alleged hybrid and shews that it does not conform to the criteria of hybridization. The cytological aspects of such crosses is then discussed. From an F_1 mono-haplont arising from the development of one parental genom only, a typical diploid F_2 zygote giving typical haploid gametes might result. Such " hybrid " pseudo-parthenogenesis might affect the ovum or pollen cell, thus resulting in matrocliny or patrocliny respectively ; Tschermak suggests that the patrocliny of the lentil-vetch hybrid may be a case of this kind. The various intermediate types between Mendelism, chromosome addition and pseudoparthenogenesis and also the possible combinations and partial combinations of some or all of these phenomena are dealt with ; and it is suggested that the matroclinous wheat x barley hybrids reported may be primarily instances of " hybrid " pseudoparthenogenesis. The cytological tests for this condition are enumerated and are being applied by the author to a possible pea x vetch hybrid and a pea x bitter vetch cross.

A bibliography with annotations bearing on the text is appended.

113. Avdulow, N. 633.1:576.312.35:582
(Supplementary karyological data on the systematics of grasses).
Bull. Appl. Bot. Leningrad 1933 : Ser. 2 (2) : 131–36.

In continuation of his earlier monograph (see " Plant Breeding Abstracts," Vol. III, Abst. 40), the author reports a grass with the very uncommon basic chromosome number 11, viz. *Aristida* with 44. It is possible that the neighbouring genus *Stipa* contains forms with 22 chromosomes. This seems a possible transitional stage between the group characterized by 12 and that characterized by 10 chromosomes or multiples thereof. The chromosomes are also smaller than those of the rest of the *Agrostideae* and the leaf morphology is in many ways intermediate between the *Phragmitiformes* and *Sacchariferae* types.

The genus *Gynerium*, closely related to *Phragmites* in a great number of characters, was found to have 72 chromosomes, i.e. a multiple of 12, which confirms its systematic position near to *Phragmites*.

The species *Aeluropus litoralis*, removed from the *Festuceae* to the *Sacchariferae* on various morphological grounds, proved, as expected, to have chromosomes in multiples of 10, viz. 2n = 20 in one form, 2n = 60 in another, together with varying numbers of fragments.

114. 633.1:576.356.4
Avdulov, N. and Titova, N. 633.1:576.16
(Additional chromosomes in *Paspalum stoloniferum* Bosco.)
Bull. Appl. Bot. Leningrad 1933 : Ser. 2 (2) : 165–72.

One third of the material fixed from 3 plants growing in one pot proved to have 23 instead of the normal 20 chromosomes. The plants were nevertheless morphologically in all respects identical. The 10 chromosome pairs are of 7 distinct morphological types, all of which are also detectable in the 23 chromosome race with the addition of 3 distinct and much smaller chromosomes. Several other species of *Paspalum* have chromosomes of such a size and one possibility is that the 3 supernumerary chromosomes have been introduced by hybridization. Reference is made to other graminaceous plants where the addition or loss of certain chromosomes has little or no genetic effect, from which it is concluded that these chromosomes are impoverished or devoid of genes. It is suggested that this is one of the stages in the process whereby chromosomes are gradually eliminated, resulting in the evolutionary fall in the basic chromosome number.

WHEAT 633.11

115. Voss, J. 633.11 *T. vulgare* (43)
Morphologie und Gruppierung der deutschen Weizensorten. (Beschreibende Sortenkunde von *Triticum vulgare*). [**Morphology and classification of German varieties of wheat. (Varietal descriptions of *T. vulgare*).**]
Mitt. biol. Reichsanst. Land. u. Forstw. 1933 : **45** : 112 pp.

The author discusses the use and value of the various characters of the seedling, growing and

mature plant, ear and grain which he uses for the diagnosis of the varieties. The characters are also illustrated. There follows a key for the diagnosis of the main wheat varieties grown in Germany, the main characteristics of each variety in turn being then given in table form. An alphabetical index of the varieties terminates the work.

116. 633.11:575(45)
L'Istituto Sperimentale di Cerealicoltura di Bologna alla IIa Mostra Nazionale del Grano in Roma, Ottobre 1932–X. (**The Istituto Sperimentale di Cerealicoltura of Bologna at the second national wheat exhibition in Rome, October 1932.**)
Contributo di Propaganda alla " Battaglia del Grano," Ist. Sper. Cerealicolt. Bologna 1932 : pp. 13–18.

An account of the work of the Institute as illustrated at the 1932 exhibition. A number of promising lines have been selected from certain varieties and from the progeny of natural and artificial crosses. Earliness is the first consideration in combination with resistance to disease and lodging and good commercial qualities.

117. SERIN, E. 633.11:575(45)
L'amélioration des blés par sélection généalogique. Une visite aux centres italiens de génétique de Bologne et de Riéti. (**Wheat improvement by pedigree selection. A visit to the Genetic Centres of Bologna and Rieti.**)
Publications Agricoles de la Compagnie des Chemins de Fer du Midi.

The production of superior varieties at Bologna is based on rigid selection and the utilization of mutations, no hybridization being employed. Several of the varieties evolved are briefly described, the most outstanding being " Inaletabile " No. 38, a form obtained from Vilmorin's " hybride hâtif Inversable," the Italian variety being noted for its remarkable resistance to lodging derived from the French variety which it surpasses in early maturity and resistance to rust, without having suffered any decrease in productivity. In poorer soils, however, this variety is subject to heat injury.

At Rieti hybridization is the main method used, directed towards the combination of high yield with adaptation to southern climates, i.e. early maturity and resistance to heat injury. Among the outstanding varieties produced is Carlotta Strampelli. Other hybrids such as Ardito and Riccio were obtained by crossing " Wilhelmina Barbu 21 " and " Wilhelmina M. 67 x Rieti " respectively with a Japanese variety Akagomughi, remarkable for its extremely early maturity, though otherwise very inferior. Of these two productions " Ardito " is a great advance upon Carlotta. Other hybrids from crosses of Akagomughi are being tested.

The question of climatic adaptation is mentioned and the author's views on certain points bearing on future work are given. The origin and resources of the two Italian breeding centres are compared with the lack of such centres in France where they moreover are dependent mainly on the enterprise of commercial firms or of private individuals.

118. 633.11:575.061.6
GALGÓCZY, M. 633.11:581.46:575
A búza kalászjellegének kerésztezés utáni öröklése. (**Segregation and inheritance of some ear characters in wheat crosses**).
Kisérletügyi Közlemények 1933 : **36** : 45–54.

In 1930 the Royal Hungarian Plant Breeding Institute carried out a series of hybridizations with 11 varieties of wheat with the following results :—

Brown and red glumes were dominant to white the segregation ratio being 3 : 1. Lax ear too proved dominant to dense, giving a ratio of 3 : 1 ; while awnlessness as compared with awnedness resulted in a ratio of one awnless : two semi-awned : one awned.

The theoretical expectations for the cross Carman 55 x Illocsksaer 177 are tabulated ; attention is called to the percentage increase of true-breeding types in the F_3, making selection on the basis of external characters profitable.

119. 633.11:575"793"
McKinney, H. H. and Sando, W. J. 633.11:581.143.26.03
Earliness and seasonal growth habit in wheat as influenced by temperature and photoperiodism.
J. Hered. 1933 : 24 : 169–79.

The earliest work on the chilling of germinated wheat seeds to convert winter into spring wheat is attributed to the American Klippart who obtained his results before 1857. Natural effects of a similar kind have been observed for years in certain areas of the United States and were mentioned by McKinney in 1920. In 1928–29 the authors of the paper under review using Harvest Queen winter wheat seeds tested the effects of moisture followed by a dark period at low temperature and then by increased temperature and winter daylight treatment. The chilled seeds headed 66 days after planting and the controls 128 days. Experiments with other varieties shewed that temperatures from 37°—44°F were more favourable than lower temperatures for stimulating earliness in winter varieties and that low temperatures retarded spring wheats. The optimum duration of the chilling period for germinated seed is determined not only by varietal characteristics but also by the conditions of temperature and light prevailing during the subsequent growing period. In the author's opinion temperature and the photoperiod constitute the two major environmental factors that condition earliness in wheat, and within limits their action is compensatory. It has been found that the reduction in yield of seed due to accelerated sexual reproduction is less when plants are grown under suitable conditions of light and temperature during the initial growth phase than when extreme earliness has been induced in germinated seeds chilled in the dark. Moreover in the instance cited the plants headed in 88 days, i.e. one day earlier than the plants from chilled seed.

Varieties differ widely in their temperature and length of day requirements for earliness.

Environmental conditions tending to favour earliness also reduced the number of internodes per culm. Other physiological factors involved are growth rate of the internodes and the duration of their elongation period.

The question of the temperature requirements for the various growth phases in a single plant, also varietal differences in these respects and the possible genetic basis of such responses are touched upon.

Seasonal growth habit in wheat is to be considered as an aspect of earliness and lateness.

In view of (a) the reversal phenomenon observed in certain instances in the order of heading of a variety and (b) the conclusion that earliness is influenced by several characters, it is evident that populations that are segregating for earliness and lateness should be tested as far as possible under several suitable conditions of temperature and day length.

120. Rosenquist, C. E. 633.11–2.111–1.521.6:575.11
Winterhardiness in the first generation of several wheat crosses.
J. Amer. Soc. Agron. 1933 : 25 : 528–33.

A comparison of winterhardiness in 522 hybrids and 1,055 parent plants. Varieties numbering 15, some hardy, some intermediate and some non-hardy were used in 21 different crosses. Of these crosses 6 yielded intermediate hybrids, 9 gave hybrids hardier than the superior parent and 3 gave hybrids as hardy as that parent. On the other hand 3 out of the 21 hybrids were as non-hardy as the less hardy parent.

From the results no definite conclusion can be drawn as to dominance or even inheritance of winterhardiness in wheat crosses. It seemed possible that those hybrids that were superior to the hardier parent may have owed their superiority to hybrid vigour effects, since crosses shewing vigour as measured by plant weight were as a rule hardier than the parents.

121. Quisenberry, K. S. and Clark, J. A. 633.11:575.11:581.46
Inheritance of awn development in Sonora wheat crosses.
J. Amer. Soc. Agron. 1933 : 25 : 482–92.

Sonora wheat which is weakly awnleted was crossed with (1) Quality, a strongly awnleted type,

(2) Supreme which is awnless, and (3) Reliance which is awned. The resulting plants were grouped as awnless, apically awnleted, awnleted, short-awned, or awned.
The F_1 of the Sonora x Quality cross were apically awnleted with less developed awns than either parent. Transgressive segregation exceeding both the parental types occurred in F_2. The F_2 ratio when corrected from the breeding behaviour in F_3 suggested the existence of a difference of two major factor pairs, and since both parents were awnleted and both awnless and awned segregates were obtained, it seems likely that each parent carries one dominant factor pair for the awnless condition. The genotypes aaBB for Sonora awnleted AAbb for Quality awnleted and AaBb for the apically awnleted F_1 fitted in fairly closely with the F_2 and F_3 behaviour observed.
In the Supreme x Sonora cross the F_2 relationships found indicated a single factor difference and ratios in accord with the assumption of an aaBB genotype for Sonora and an AABB genotype for Supreme.
The segregation in the Sonora x Reliance cross could not be completely explained by the action of a single major factor difference. The genotype of Reliance is assumed to be aabb.
The percentage of awnleted segregates is suggestive of a 2-factor difference though the absence of true breeding short-awned strains rather argues against this view. It is possible that minor genetic factors were operating in this cross.

122. Bryan, W. E. and Pressley, E. H. 633.11:575.11.061.5:581.48
Hard grain texture of wheat in mechanical mixtures and in crosses.
J. Amer. Soc. Agron. 1933 : **25** : 64–69.
A six year test of a mixture of a hard Baart strain and a soft Baart strain shewed a gradual preponderance of the soft strain and a higher average number of grains per plant in the soft than in the hard strain ; and this excess was due mainly to the greater number of heads per plant in the soft strain.
The segregation of hard texture was demonstrated in a hard Baart x Sonora cross. A single main factor with numerous modifying factors is tentatively suggested as the genetic basis.

123. Crescini, F. 633.11:575.113
Effetti simili prodotti da fattori genetici diversi in *Trit. vulgare* (Vill.) **[Similar effects produced by different genetical factors in *Trit. vulgare* (Vill.)]**
Ital. Agric. 1933 : **70** : 581–88.
Two pure lines selected from Todaro and differing slightly in density and in the length of the awns which occur as traces on the upper spikelets, both without occurrence of supernumerary spikelets and up to 1931 relatively resistant to rust, were crossed and gave an awnless F_1. Of the 41 plants of the F_2 13 were definitely awned. The ratios in F_3, 308 awnless plants and 116 awned suggests that the parents must have at least two factor pairs for awnlessness one of which must be heterozygous.
In the wet summer of 1932, the parent lines were severely attacked by black stem rust, (*Puccinia graminis*) but the F_3 progeny were only slightly affected.
The grain weight of the F_3 was also higher than that of either parent. Among the F_3 plants 5·66 per cent had supernumerary spikelets.

124. Bonvicini, M. 633.11:575.12
Studio genetico di un incrocio spontaneo di grano (" Ibrido " 62 : Piave x Inallettabile). **[A genetical study of a spontaneous wheat cross (" Ibrido " 62 : Piave x Inallettabile.)]**
Ist. Allevamento Veg. Cerealicolt. Bologna 1932 : Pp. 63.
The original hybrid was found amongst a culture of Piave 62 and its characters and those of its progeny up to F_5 are described in detail. No genetical analysis is attempted but the following characters behaved as recessives ; short stems, strong stems, white ears, the laxness of Piave, glabrous glumes, awns, the Inallettabile grain type and resistance to rust. Selection has been made on the basis of resistance to rust and lodging and for the Piave type of grain.

125. KIHARA, H., WAKAKUWA, S. and YAMAMOTO, Y.

633.11:575.127.2:576.312.35

Weitere Untersuchungen über die pentaploiden *Triticum*-Bastarde III. **(Further investigations on pentaploid *Triticum*-hybrids III)**

Jap. J. Bot. 1933 : 6 : 411–24.

F_1 hybrids *T. polonicum* x *T. Spelta* and *T. vulgare* x *T. durum* were pollinated with the respective hexaploid and tetraploid parents. In each case the tetraploid parent gave hybrids with predominantly low chromosome number, maxima being at 16 and 14 in the two crosses respectively. This indicates that with pollen of the tetraploid mainly egg cells with 14–17 chromosomes are fertilized. The hexaploid parent on the other hand produced hybrids with higher chromosome numbers, maxima being at 18 and 19 ; although the excess in this case was not nearly so marked it is clear that the 18–21 chromosome egg cells were more active. These results fail to support the assumption that the euploid embryo sacs, especially the 14 chromosome ones, are in all cases the most active.

Using the different species as female parents and pollinating with the hybrids, almost exclusively 14 chromosome pollen functioned on the tetraploid female and on the hexaploid both 21 chromosome and 14 chromosome pollen functioned, the former rather more frequently ; the intermediate numbers were functionless in both cases. Direct experiments of pollinating *T. vulgare* with a mixture of *vulgare* and *durum* pollen have shewn that only one *durum* pollen grain to every 10 *vulgare* succeeds in effecting fertilization, from which it is seen that the number of 14 chromosome pollen grains in the above hybrid pollen must have been 7 times the number of 21 chromosome grains. Similar calculations lead to the assumption that the proportion between the 14 and 21 chromosome embryo sacs is 6 : 1.

Taking the product of percentage set, percentage germination and frequency of individuals with 28 and with 35 chromosomes in the F_1 x *durum* cross a frequency of 17·4 per cent embryo sacs with 14 chromosomes and 1·9 per cent with 21 chromosomes is calculated.

In comparison with the *T. vulgare* x *durum* hybrid, the *T. polonicum* x *T. Spelta* hybrid had not such a pronounced excess of 14 chromosome gametes, apparently owing to the less rigorous univalent elimination.

126. WAKAR, B. A. 633.11:575.127.2:576.356

Cytologische Untersuchungen über F_1 der Rassen– und Artbastarde des Weizens. **(Cytological investigations on the F_1's of interracial and interspecific hybrids in wheat).**

Angew. Bot. 1933 : 15 : 203–24.

The study was made on a hybrid between a pure line of *Triticum vulgare lutescens* and a 28 chromosome hard, awnless, blue-eared wheat from a cross *T. durum coerulescens* x *T. vulgare nigrum*, known as *T. durum Talanovi*.

In the hybrid 21 chromosomes are clearly distinguishable at metaphase I, consisting of 14 bivalents and 7 univalents ; the latter split but frequently fail to divide and are distributed to the poles at random ; they are said to be often " extruded " into the plasma. The number of univalents often considerably exceeds seven (13 and probably more) some apparently being derived from the 14 paired chromosomes. Both regular and irregular telophases have been observed and lagging or occasionally precocious chromosomes are frequent in the second division. Similarly, both normal and abnormal tetrads and pollen grains are to be observed.

Hence by a repeated cross with the *T. vulgare* parents the meiotic irregularities are not reduced, but if anything augmented, the behaviour here observed being more irregular than the usual behaviour of ordinary pentaploid hybrids. Irregularities were still observed in the seventh generation of a *T. vulgare* x *T. durum* cross and it seems as if some definite incompatibility exists between the chromosomes of these two species, which is naturally accentuated in a triple hybrid of the kind under investigation.

The meiosis in an ordinary pentaploid hybrid, *T. vulgare lutescens praecox* x *T. durum hordeiforme* which was examined for comparison confirmed the impression that the irregularities, which were of the same type as in the triple hybrid, were less pronounced.

Comparison was also made with a hybrid between two species of equal chromosome number, *T. persicum fuliginosum* x *T. durum hordeiforme*. Here 14 bivalents were regularly observed, mostly closed though at least two end-to-end associations were invariably present and the premature passage of certain chromosomes to the poles was not infrequent. Telophase and tetrad formation were invariably regular. In spite therefore of the great morphological resemblance of *T. persicum* to *T. vulgare* its nuclear behaviour proves quite distinct.
The meiotic behaviour of the hybrid *T. vulgare milturum* 0321 x *T. vulgare albidum* 0721 on the other hand was by no means always regular, no less than 54 (36 per cent) figures displaying irregularities being found in 150 figures examined ; premature passage of bivalents to the poles and lagging of the chromosomes at anaphase were frequent irregularities. Telophase and tetrad formation were regular.
It is evident therefore that even in crossing forms with the same chromosome number the choice of parent has considerable influence on the nuclear behaviour, and interracial crosses can be less regular in behaviour than crosses of different species with the same chromosome number. The cross *T. durum* x *T. persicum* is of particular interest on account of the low cultural requirements, drought resistance and earliness of the latter species, qualities which it is desired to introduce into *T. durum* ; crosses with forms of *T. vulgare* possessed of these qualities have failed to introduce them on account of the chromosome irregularities such as those in the cross here described, with *T. vulgare lutescens praecox*, which was undertaken for this purpose.

127. 633.11:575.127.2:581.331.1
WAKAKUWA, S. 633.11:575.127.2:581.48
(Differences in growth in embryos and endosperm in reciprocal crosses of wheat species.)
Jap. J. Genet. 1933 : 8 : 278–80.
In reciprocal crosses of wheat differing in chromosome number the percentage set was found to be low and the germination good when the ♀ parent had the larger chromosome complement ; but reversal of the parental chromosome relationship resulted in satisfactory set but poor germination. A corresponding relationship was found between the endosperm development of hybrids and the paternal and maternal chromosome numbers.
Crosses of *T. Spelta*, *T. polonicum* and *T. aegilopoides* bore out the above observations and indicated that the inferior germination capacity found when the ♀ parent had fewer chromosomes was due to defective growth of the endosperm and embryo.

128. BLARINGHEM, L. 633.11:575.127.5:633.11*Aegilops*
Hybrids of *Aegilops* and *Triticum*.
Proc. 6th Int. Cong. Genet. 1932 : 1 : p. 370.
A pollen-sterile *Ae. ventricosa* x *T. turgidum* hybrid was pollinated by *T. turgidum* and gave partially self-fertile plants in F_8. Among the progeny a new type of *T. Spelta* with non-imbricated ears, 3—5 grains per spikelet and free glumes, named *T. Spelta polycoccum* was obtained.

129. KAGAWA, F. 633.11:575.127.5:633.14:576.3
(Cytological studies on the formation of pollen grains in the hybrid plants between *compactum*-wheat and rye).
Proc. Crop Sci. Soc. Japan 1933 : 5 : 102–06.
T. compactum ♀ was crossed with *Secale cereale* ♂ and 8 F_1 plants were obtained of an intermediate type but completely sterile.
A cytological examination of the pollen mother cells shewed 28 univalents, only rarely 1—3 bivalents occurred.
Large pollen grains were frequently observed with the diploid number of chromosomes and arising from restitution nuclei. The author therefore concludes that a stable amphidiploid type might readily occur.

130. STEINER, H. 633.11:575.127.5:633.14–2.452
Über die Braunrost- (*Puccinia triticina* und *Puccinia dispersa*) Anfälligkeit von reziproken Bastarden zwischen Weizen und Roggen. [**Reaction to brown rust (*P. triticina* and *P. dispersa*) of reciprocal hybrids between wheat and rye**].
Züchter 1933 : **5** : 179–80.

Tschermak's fertile 42 chromosome wheat-rye hybrid (see " Plant Breeding Abstracts " Vol. I., Abst. 313) and the reciprocal which he has more recently obtained (see " Plant Breeding Abstracts," Vol. IV, Abst. 112) were tested with both wheat and rye rusts. To the former (*P. triticina*) both the hybrids were completely susceptible, and to the latter immune.

131. NILSSON, E. 633.11:575.242:632.451.3
Paralleles Auftreten von *Tilletia*–Infektion und Speltoidcharakter bei *Triticum vulgare*. (**Parallel occurrence of infection by *Tilletia* and the character speltoid in *Triticum vulgare*.**)
Hereditas 1933 : **18** : 262–68.

A single healthy grain occurred in a lot of 20 bunted ears of Standard wheat, from which a healthy plant was obtained, the grains of which were heavily infected before sowing.
The plants arising from these grains were some normal, some however entirely speltoid and others mosaics of speltoid and normal. The two latter types were heavily infected, whilst the normal ears remained entirely free from bunt ; the normal portions of the mosaic ears were, moreover, infected as badly as the speltoid portions.
It is regarded as improbable that the bunt was the direct cause of the mutation in the original individual. It is also thought improbable that the mother plant was a heterozygous speltoid, in all the characteristics of which it was lacking. It is suggested therefore that the mother plant was a chimaera containing speltoid tissue, the manifestation of which in the progeny was the direct result of the action of the bunt, after which the speltoid zones or plants, being more susceptible than the normal, were more severely attacked. In support of the hypothesis reference is made to the production of speltoid mutants under the influence of X-rays.

132. NEATBY, K. W. 633.11:575.242.061.6
A chlorophyll mutation in wheat.
J. Hered. 1933 : **24** : 159–62.

In Line No. 221 among the F_6 from a Garnet x Double Cross a mutation resulting in delayed development of chlorophyll appeared. This virescent yellow mutant ultimately yielded 38 seeds from three ears and 553 seeds were ultimately obtained, though the mutant will not thrive at a temperature below 60°F. Mutant seed was grown for crossing with Garnet x Double Cross, Line 221 ; and this cross and its reciprocal, Line 221 x Mutant, shewed the anomaly to be determined by a single factor pair. This was borne out by the cross of Mutant x Garnet but the cross Mutant x Double Cross gave relatively too few mutant type seedlings in F_2, a deficiency which may be due to genetical causes.
One instance of complete reverse mutation to green and four cases of somatic mutation in small portions of tissue are regarded as evidence of the instability of the new gene ; and the occurrence of a true albino seedling in the progeny of the green plant that arose from the mutant is cited in support of the author's contention of gene instability.

133. TITTA, G. 633.11:575.4
Sopra un miscuglio di cinque razze di frumento. (**On a mixture of five varieties of wheat**).
Boll. R. Ist. Sup. Agr. Pisa 1932 : **8** : 555–64.

A study of the behaviour of a mixture of five varieties of wheat as compared with the outcome of separate cultivation of the individual variants. From a consideration of the results and of Vilmorin's and Darwin's views on competition in populations the writer concludes that continued cultivation of a mixture of varieties will not for a very long time lead to the disappearance of the least adapted constituent varieties, but the mixture will give better and better results so that finally its annual mean yield will be slightly higher than the annual mean total yield for all the relatively superior varieties grown separately.

In a single variety on the other hand in a new environment under continuous cultivation, the number of plants of superior lines will go on increasing and hence the average yield of the variety will tend to increase and will approach the general average of these same superior lines ; these may eventually separate out into distinct pedigree strains ; finally, however the yield of these pedigree strains later tends to diminish owing to the appearance of " collateral lines."
Pedigree selection should therefore be carried out in relation to a definite environment and rarely continued if the variety is becoming degenerate. Also in each environment a certain number of lines or races of the same variety should be cultivated if a constant total yield is to be obtained. But the association of lines is not as advantageous as an association of varieties since the competition among lines is too severe.

134. MUNERATI, O. 633.11–2.451.2–1.521.6:575.42
Sulla possibilità di separare razze resistenti al carbone entro le comuni varietà di grano. (**On the possibility of isolating races resistant to smut among the common varieties of wheat.**)
Ital. Agric. 1933 : **70** : 383–85.
Seed selected from plants of Gentile Rosso attacked in varying degrees by *Ustilago tritici* gave plants which shewed no relation in their resistance to smut of the amount of infection shewn by the parents.

135. MUNERATI, O. 633.11–2.451.2/3
Sulla possibilità di una coesistenza dei funghi del carbone e della carie su una medesima pianta di grano. (**On the possibility of a co-existence of the fungi of smut and of bunt on the same plant of wheat).**
Ital. Agric. 1933 : **70** : 631–35.
Smut and bunt were both found on the same ear in plants experimentally infected with both fungi. In some cases the smut attacked the external tissue and bunt the internal or half the ear was infected with smut and the other half with bunt. Healthy ears might also occur on the plants so attacked.

136. MUNERATI, O. 633.11–2.451.3–1.521.6:575.42
È possibile separare delle comuni varietà di grano razze o linee resistenti alla carie ? (**Is it possible to isolate from the common varieties of wheat races or lines resistant to bunt ?**)
Ital. Agric. 1933 : **70** : 25–27.
Seed of Gentile Rosso and Ardito Strampelli was inoculated with spores of *Tilletia tritici* and sown separately. Of the resulting plants, about 1 per cent were free from bunt and seed from these was sown but all the plants were more or less infected and though seed from the most resistant plants was again sown, it was already clear that selection, at least from these plants, of the two varieties tested would not yield resistant biotypes or lines.

137. 633.11–2.452 *P. glumarum*–1.521.6
RADULESCU, E. 633.11:581.49:575
Beiträge zur Kenntnis der Feldresistenz des Weizens gegen *Puccinia glumarum tritici*. (**Contribution to the study of field resistance of wheat to *Puccinia glumarum tritici*.**)
Planta (Berl.) 1933 : **20** : 244–86.
As part of the method of attack upon the main problem of field resistance the rhythm of opening of the stomata was investigated during 1931 and 1932 in 144 spring and winter wheat varieties and in 87 hybrid progenies. Of these 42 varieties were found to open their stomata very early, 45, early, 44 late and 13 very late. In spite of admitted technical difficulties in satisfactorily determining the rhythm for the progeny, it is concluded that the time of stomatal opening is probably conditioned by several genetic factors. But further study of the genetic aspect is necessary.
Field resistance was not dependent on stomatal behaviour in the varieties tested.

138. 633.11–2.452 *P. triticina*–1.521.6:575
CALNICEANU, C. 632.452 *P. triticina*:576.16
Beiträge zur Resistenzzüchtung gegen *Puccinia triticina* Erikss. **(Contributions to breeding for resistance to *Puccinia triticina* Erikss.)**
Kühn-Archiv 1933 : **37** : 59–90.

From isolations of 1,880 spores, 248 pustules developed, an infection percentage of 13·2. Infection material from single spore cultures was used throughout the experiments. From each spore a single pustule only developed.

A mixture of rust forms 13 and 15 was used to infect a variety susceptible to both forms. Of the 33 pustules developed 12 contained only form 13, 13 only form 15 and 8 contained both. On Malakoff, a variety susceptible only to form 13, only this form caused pustules, form 15 only flecks ; the degree of infection varied with the proportion of form 13 in the mixture. Similarly on the variety Mediterranean only form 15 developed, whilst on Loros large pustules of form 13 and small ones of form 15 were formed. All these infection types correspond to the reaction of the respective varieties to forms 13 and 15 when applied alone.

By applying the form to which the wheats were resistant or immune a few days later than the other form, still the same reactions were observed, as also when infection was carried out on plants already attacked by *Tilletia tritici*. Thus in spite of the possibility of mixed pustules it is clear that the different races of the fungus retain their independence in the host tissue and the experiments demonstrate the rigour with which natural selection of the rust races must take place in nature.

Observations were made on the rust forms occurring in 1932 in various parts of Germany and Rumania and on the reaction of a number of wheat varieties from various parts of the world to 6 races of the fungus ; in all 479 varieties, of which a list is given, were tested. The reactions of those varieties which displayed any degree of resistance is tabulated. In addition to fully susceptible varieties, 21 varieties of *Triticum vulgare* proved resistant to one form or other and 3 varieties, Ardito, Aurore and Varonne were resistant to all 6 forms. Varieties resistant to forms 11 and 14 in the greenhouse were also resistant in the field. Other varieties although attacked in the greenhouse proved resistant in the field ; this applied, among others, to the 2 German varieties Heine I and II, recently bred for resistance to *P. triticina*. All varieties of *T. durum* tested were resistant to all 6 forms.

Details are given of the behaviour of various hybrid spring wheats to races 11, 13, 14 and 15 of the fungus. An F_5 of Peragis (susceptible to all 4, strong straw) x Normandie (susceptible to form 13, resistant to 11, 14 and 15 and to yellow rust, weak straw) proved almost homozygous and susceptible to form 13 ; some lines were resistant to forms 11, 14 and 15 and of these lines one shewed field resistance, resistance to yellow rust and strong straw.

In the F_6 of the winter wheat crosses 98_{26} x 41_{26}, both somewhat susceptible, some families exceeded both parents in resistance to form 15, both in the greenhouse and in the field, where they proved resistant to all forms present. Similarly the F_6 of Rimpaus fr. Bastard x Kronenweizen contained certain lines exceeding the parents in resistance to forms 11 and 15, which, although susceptible in the greenhouse to forms 13 and 14, were resistant in the field to both brown and yellow rust and had very stiff straw.

139. CLARK, J. A. and HUMPHREY, H. B. 633.11–2.452–1.521.6:575.11
Inheritance of stem-rust reaction in wheat.
J. Amer. Soc. Agron 1933: **25** : 497–511.

Following the discovery of two new varieties, Hope and $H–_{44}$, derived from a Marquis x emmer cross, and possessing a new genetic character, near immunity to stem rust, the genetic relationships of this reaction were analysed in conjunction with the susceptibility reactions of Marquis, Reliance, Supreme, Power and Reward, and the resistance exhibited by Ceres.

Imperfect dominance for near immunity is suggested by the data in the Hope and $H-_{44}$ crosses with the susceptible and the resistant varieties ; while Ceres x Power shewed an intermediate reaction. The presence of 2 factor pairs for the near immune condition is indicated by the Hope x Marquis and Hope x Reliance crosses, whilst the crosses with Supreme and Power might be explicable on a basis of 3 or more factors. The occurrence of homozygous intermediate strains

and of several types of segregation in the Hope x Reward cross shewed that the conditions here were more complicated than a monohybrid relationship.
The Hope x Ceres and the H-$_{44}$ x Ceres crosses indicated in the former a single factor difference and in the latter a 2-factor difference with transgressive segregation for greater infection. When compared the Hope x Power and the Ceres x Power results are of special interest in that they demonstrate that the near immune reaction of Hope is a new character inherently different from Ceres resistance.
The similarity in the mode of inheritance in the H-$_{44}$ x Ceres cross and in the Hope x Marquis and Hope x Reliance crosses is interpreted as shewing that Hope has a single dominant inhibiting factor for near immunity, that Marquis and Reliance have a dominant factor for susceptibility and that H-$_{44}$ carries both of these dominants and the resistant Ceres bears the double recessives.
The possibility of modifying factors affecting the immunity reaction is discussed.

140. Åkerman, Å. 633.11–2.7–1.521.6
Några aktuella spörjsmål rörande vete odlingen i Skåne. (**Questions of current interest on wheat cultivation in Scania.**)
Skånsk JordbrT. 1933 : No. 30 : 477–83, No. 31 : 493–96.
In discussing the damage done by the wheat midge the production of varieties that are either extremely early or extremely late in earing is suggested as a possible means of combating the pest. That other resistance factors besides the time of earing must however be considered by the breeder is evident from the fact that Kron wheat is more severely attacked than the new strains 01090 obtained by crossing Kron and the variety 0860 d, though 01090 comes into ear at the same time as Kron. Moreover, in 1929, 1930 and 1932 the percentage of injury due to the midge was lower for 01090 than the average for all other varieties that came into ear on the same day. It is suggested that the superior resistance of 01090 may be due to the fact that the ear emerges from the sheath more rapidly than in Kron wheat.
The second part of this paper contains inter alia data on the loaf volume, dough weight and raw protein content of the main wheats produced in Sweden, with remarks on baking quality.

141. Boerger, A. 633.11:664.641.016(82)
Umweltseinwirkungen auf die erblich bedingte Backfähigkeit einiger La Plata-Hochzuchtweizen. (**The action of environment on the hereditary baking quality of certain high-bred La Plata wheats.**)
Züchter 1933 : **5** : 145–56.
After a rather full discussion of the various factors controlling baking quality and their determination, the ever increasing disharmony between the industrial methods and the results of scientific investigation is emphasized.
The quality of the various wheats was distinctly lower in the years with the worst weather conditions. Different varieties gave the best quality product at different times of sowing.

142. Cutler, G. H. and Worzella, W. W. 633.11:664.641.016:578.081
The wheat-meal fermentation time test of "quality" in wheat as adapted for small plant breeding samples.
Cereal Chem. 1933 : **10** : 250–62.
Further studies of Cutler and Worzella's fermentation time test which is based on the principle of the Saunder's flour test, but using wheat meal instead of flour. The validity of "time" as an index of gluten strength in wheat is confirmed. The technique has been subjected to further study and full details of how to obtain the best results are given. A new fermentation cabinet has been devised.
Among the particular advantages of this method are :

1. The small amounts of wheat needed (3·5 g. have been successfully used).
2. Low cost.
3. The breeder can test large numbers of wheat selections in the early segregating generations and thus estimate the potential "quality" of his hybrids.

Significant positive correlations were obtained between "time" and other properties used in

evaluating quality in wheat, viz. protein content (flour), loaf volume, absorption and vitreous grains. High positive correlations between the results in different seasons for hybrid selections and pure line strains grown under similar environment indicated that " quality " in wheat is genetically conditioned and is correctly measured by the fermentation test; also strains selected for " quality " from standard varieties by the " time " test shewed genetic differences.
A classification for pastry and for bread wheats might possibly be based on " time " ; and flour granulation in pastry wheats, in so far as is correlated with berry texture, can be detected by the fermentation test.

143. *Hauser, J. 633.11:664.641.016:578.081
A minöség elbírálása a gyakorlati búzanemesítésnél. (**The determination of quality in practical wheat breeding for improvement.**)
Mezgöazdasági Kutatások 1933 : **6** : 140–45.

In breeding for quality in wheat the requisite constant control of the quality of the breeding stocks may be ensured by (1) the determination of the specific gravity and the degree of flintiness of these grains and (2) by Pelshenke's (" Plant Breeding Abstracts ") Vol. I., Abst. 340., Vol. III., Abst. 391.) method of estimating the quality coefficient and the specific protein quality deducible therefrom.
A comparison with identical material of the results obtained by using Hankóczy's farinograph to determine the gluten quality coefficient of various flours and by using Pelshenke's test shewed that Pelshenke's coefficient was undoubtedly correlated with the quantity and quality of the gluten. It is concluded that Pelshenke's test for which no expensive apparatus is needed and which can be carried out with a small quantity of wholemeal instead of flour is to be regarded as a simple and economical method of quality estimation for the practical breeder.
Further experiments are contemplated.

OATS 633.13.

144. Granhall, I. 633.13(48.9)
Svenska havresorter i danska försök. (**Swedish oats in Danish tests.**)
Sverig. Utsädesfören. T. 1933 : **43** : 121–28.

Results with various varieties are described and some promising crosses between Örn and Sölve inter alia are mentioned as likely to yield an Örn oat with larger grains.

145. *Závada, J. 633.13:575(43.72)
Z krajové sorty výběrem získaný zlutý oves. (**On the local variety of yellow oats obtained by selection.**)
Ceskoslov. Zemed. 1933.

With the object of producing a yellow oat with a high yield of grain and good straw suitable for fodder and resistant to lodging, a large number of local varieties from North Moravia were selected and used as material for improvement. Ultimately the yellow-grained " D " lines were isolated and these on being compared in three-year trials with Dreger's Petkus yellow oat and Svalöf Seger gave the following results :—
In average yield of grain and straw for the three years, and in hectolitre weight the " D " lines took first place, while in the weight of 1,000 grains the " D " oats were second, Svalöf Seger having proved superior.
As regards the amount of husks present " D " oats were found to have 1·3 per cent in excess of Dreger's Petkus yellow but were superior to Svalöf Seger. Though both earing and full emergence of the spike were from 2–3 days later in the " D " type than in Dreger's Petkus yellow both varieties were ultimately harvested on the same day.
The " D " variety also proved its superiority in a population of all 7 original lines in a field test under ordinary conditions in 1930, by yielding 24·48 quintals of grain and 44·42 quintals of straw as compared with the respective averages of 21·0 and 40·0 for all varieties cultivated.

* A full translation of these papers is on file at the Bureau.

146. 633.13:575.113.42:581.49
ÅKERMAN, Å. and MÜHLOW, J. 633.13:576.356.5:575.113.42
Über die Vererbung des Ligulamerkmales beim Hafer. (**On inheritance of the ligule in oats.**)
Hereditas 1933 : **18** : 140–44.
The author describes the results which he himself obtained by repeating the cross upon which Nilsson-Ehle's assumption of four factors governing the inheritance of the ligule was based. Reciprocal crosses with parents from exactly the same pure lines as Nilsson-Ehle had used were made and the resulting segregation was found to correspond to a 3 factor instead of a 4 factor ratio. By thus demonstrating that the action of 3 homomeric factors condition the ligule this investigation eliminates the discrepancy between the number of genetic factors for the ligule and the other characters in oats and also brings the facts into line with the theory of the relation between polyploidy and homomeric factors.

147. NISHIYAMA, I. 633.13:575.127.2:576.354.46
(**Change in the number of chromosomes in descendants from hybrids between species of oats.**)
Jap. J. Genet. 1933 : **8** : 275–76.
Triploid hybrids from *Avena barbata* (n=14) x *A. strigosa* (n=7) and from *A. barbata* (n=14) x *A. Wiestii* (n=7) shewed the normal $7_{II} + 7_{I}$ in the first maturation division of the pollen mother cells and the gametes contained 7 — 14 chromosomes. In the F_2 the diploid number varied between 14 — 28, both increasing and decreasing groups being present.
In the pollen mother cells of a pentaploid hybrid from *A. barbata* (n=14) x *A. fatua* (n=21) the number of bivalents was 2 — 11. In spite of a marked tendency to sterility selfing yielded some seeds. F_1 was also successfully crossed by *A. fatua*, the chromosome complement of the progeny varying from 42—67. Conjugation also was highly irregular. One possible explanation of these high chromosome numbers is that by translocation or inversion partially homologous chromosomes are formed and these are characterized by weak pairing.
The fundamental difference between the two types of behaviour in the two hybrids appears to depend on the different degrees of homology of the parental genoms in the two crosses.

148. ÅKERMAN, Å. 633.13:575.182.061.633
Untersuchungen über die Vererbung gelb und weissgestreifter Blattfarbe beim Hafer. (**Investigations on the inheritance of yellow and white striped leaves in oats**).
Bot. Notiser 1933 : 255–70.
The author describes two striped plants which were found in different cultures in 1922. Their progeny contained pure yellow, pure green and striped plants. A higher proportion of green plants appeared in the progeny of the less striped than in those of the more striped plants, just as the plants displaying the most pronounced striping gave rise to a greater proportion of yellow plants. Some apparently all-green plants gave rise to striped plants but it is probable that such plants were partially, though evidently very slightly, striped. Pure-breeding green plants were moreover rapidly obtained from the offspring of a striped plant by selection in succeeding generations. Selection in the opposite direction leads to plants whose chlorophyll content is below that required to remain alive.
Pollinations by striped plants of pure normal green lines of two varieties of oats were executed, and produced pure green F_1 and F_2 generations, whereas the reciprocal crosses gave F_1's consisting entirely of striped or yellow plants, from some of which progenies were obtained which again shewed the usual striping.
The defective plastids from which the striping results are evidently transmitted only maternally. Numerous other striped individuals have later been observed, in oats and one in barley and all behave in the same way.

149. EMERSON, R. A. 633.15:575.1
The present status of maize genetics.
Proc. 6th Int. Cong. Genet. 1932 : 1 : 141–52.

In the last 20 years more than 200 genes have been identified. Sixty genes influencing chlorophyll development have already been found. Complex genetic situations have also been revealed for such characters as aleurone and scutellum colours ; under certain conditions, of the remaining factors two of the scutellum colour genes may give 15 : 1 ratios, under other conditions, 9 : 7, shewing the interaction of genes and the essential identity of the so-called duplicate and complementary genes.

Various series of multiple allelomorphs, involving differences in dominance, are known.

Linkage has recently been demonstrated of a quantitative character with qualitative characters. Ten linkage groups corresponding to the 10 chromosomes are now known. The use of trisomics and other cytological methods gives new possibilities of studying linkage relationships. Each of the 10 pairs of chromosomes has been morphologically identified and each has now been associated with a definite linkage group. Tetraploids can be produced by heat treatment, and by crossing with diploids give triploids, which are a source of trisomics. Chromosome deficiencies and deletions, and reciprocal translocations afford a method of more accurately determining the position of given genes.

Special genes seem to exist governing the rate of mutation, others the expression of sex ; dioecious strains have been produced, some in which the male and others in which the female is heterogametic, and in all of which the sexes differ by one gene whose location is known.

The production of chromosome rings by combinations of semi-steriles, the demonstration of crossing-over in the double-strand stage, and the possible connexion of inversion with failure of crossing-over in hybrids of maize with Florida and Durango teosinte are mentioned.

150. 633.15:575.11.061.6
YASUI, K. 633.15:575.11–181.3
(Genetical studies in *Zea mays* L.)
Bot. Mag. Tokyo 1933 : 47 : 203–09.

In analysing the relation between the characters Dwarf and Yellow, the F_1 from a Tall heterozygote x Green heterozygote gave equal numbers of Dwarf Yellows, Dwarf Greens, Tall Yellows and Tall Greens. Later it was found that Yellow and Dwarf belong to different linkage groups. Certain anomalous forms that appeared are described and some are attributed to segmental interchange or loss mutation.

In a strain of white maize Shiro-Kibi, a character termed Slender (Sl) was observed. As a rule Slenders are under developed and infertile, the character being transmitted through heterozygotes only. The segregation ratio for Tall to Dwarf was 64 : 19, i.e. a monohybrid ratio which was subsequently confirmed.

Tall Purple aleurone and Dwarf White aleurone grains were obtained in an F_1 and the first subsequently segregated out White aleurone Dwarfs and White aleurone Tall, while the second type produced Dwarfs and Tall whites. Since all four classes were approximately equal in numbers it is concluded that no relation exists between the genes for Purple aleurone and Dwarf. The F_2 from these four classes shewed that Purple and White each segregated Talls and Dwarfs as 3 : 1 thus indicating that Purple-White and Tall Dwarf are not linked. The behaviour of Purple and White in F_2 indicated a dihybrid ratio.

In F_2 and F_3 dihybrid segregation of complementary factors appeared to underly the interrelationship of Tall, Slender and Dwarf, as shewn by the ratio 9 Tall, 3 Slender and 4 Dwarf.

One Tall Albino appeared in F_3 among the Tall, Dwarf and Slender progenies ; it is attributed to mutation.

151. JUGENHEIMER, B. 633.15:575.12
Hybrid corn triumphs. Inbred crosses best.
Iowa Agric. 1933 : **33** : 133, 139.
Comparative tests have for 7 years consistently proved the superiority in yield of first generation hybrids over open-pollinated strains. The hybrids averaged an increased yield of 8·8 and were more resistant to lodging.
A general description of the method for obtaining these hybrids is given.

152. BRIGGS, R. 633.15:575.125
New hybrid corn.
Success. Fmg. 1933 : **31** (2) : 5, 49.
A new hybrid maize (Hybrid M.W. 106) high yielding, upstanding and of uniform grain quality has been obtained. Another new hybrid variety S–5 derived from Golden Bantam (see " Plant Breeding Abstracts," Vol. III, Abst. 644) has been produced at Iowa State College ; it is remarkable for uniformity of size of grain and of length and size of the cobs, and for high yield as compared with open-pollinated varieties, and it is also highly resistant to Stewart's disease.

153. FISCHER, G. J. 633.15:575.125(82)
Plan de la División de Genética Vegetal para la producción de simiente de maíz de máxima potencia productiva correspondiente al tipo comercial mejor cotizado. (**Plan of the Plant Genetics Division for the production of seed maize of the highest yielding capacity of the highest commercial value.**)
Minist. Agric. República Argentina 1932 : No. 879 ; Pp. 54.
The necessity for high quality in maize for export is emphasized, although in maize for local use it is still admissible to breed for high yield.
The relative merit of different varieties in early and late sowings is reported upon. The variety Casilda was in high-yielding plots superior in yield to Cuarenton, the superiority increasing with the yield of the plots and density of sowing, and for local cultivation. The former variety is to be recommended.
An industrial hybrid between the varieties Cuarenton and Comun, possessing the grain type of the former but exceeding it in yield, has been tested. In 1928 in tests where the average yield of a number of varieties was 25 quintals, the hybrid was the only one to exceed 30 quintals per ha. Work on isolation, selection and hybridization of lines and varieties and the production of commercial hybrids on a large scale is in progress and is yielding promising results.
The plan outlined consists in the attempt to produce immediately hybrid seed from a mixed plantation of 1,000 hectares of Cuarenton colorado Klein ♀ and Colorado seleccion Casilda ♂. This is to be effected by supplying 10 trusted farmers with pure seed of the two varieties enough to sow 100 ha.
The methods of producing and the advantages of hybrid seed are briefly outlined.

154. KOZHUCHOW, Z. A. 633.15:576.312.36
Über die Natur der Extrachromosomen bei *Zea Mays* L. (**The nature of the extra chromosomes in *Zea Mays* L.**)
Planta (Berl.) 1933 : **19** : 91–116.
The nature of the extra chromosomes in maize has been investigated. The occurrence of abnormal chromosome complements and of aberrant individual cells in normal plants is recorded and explanations are suggested. The primary cause of such phenomena would seem to be chromosome segmentation due to genotype characteristics and not to environment.

155. BEADLE, G. W. 633.15:576.354.46
Further studies of asynaptic maize.
Cytologia 1933 : **4** : 269–87.
Synapsis occurs apparently normally in asynaptic plants but the paired homologous chromosomes fall apart during pachytene and the frequency of chiasmata is low at diplotene, diakinesis and metaphase. The number of bivalents at metaphase was found to vary from 0 to 10.

The results agree with Darlington's hypothesis that the post-diplotene association of homologous chromosomes is due to chiasmata.
The measurements of the first meiotic spindles shew a greater variability in length than those of normal plants. A study of the linkage relations of the asynaptic gene shewed that it lies about midway between P (pericarp colour) and br (brachytic culm).

156. 633.15:576.356.4
633.15:576.312.34
AVDULOW, N. 633.15:576.16
(On the additional chromosomes in maize.)
Bull. Appl. Bot. Leningrad 1933 : Ser. 2 (2) : 101–30.
A review of previous investigations on the supernumerary chromosomes in maize is given. On the basis of the author's investigations he makes one or two minor corrections in McClintock's description of the morphology of the 10 maize chromosomes, each of which is morphologically distinguishable. A full description is given of the chromosomes of a normal 20-chromosome individual of Black Mexican. An identical set of 20 chromosomes was observed in individuals with 22, 23, 24, 25, 26, 28 and 32 chromosomes, except for the absence of satellites in some type IV chromosomes ; of the supernumerary chromosomes, some displayed signs of a constriction, the majority had no trace whatever ; only in isolated cases was a supernumerary chromosome with a true constriction observed.
From these observations it is clear that the supernumerary chromosomes are not derived from the basal set—which is always present intact—but are an independent addition to the chromatin material. Owing to the unchanged nature of the basic set they can hardly have originated from any of the existing chromosomes.
The absence of satellites and a constriction in the supernumerary chromosomes, and the indefinite position of this when present, constitute the lack of the most essential feature characterizing a chromosome according to Lewitsky's definition. They exert, moreover, not the slightest influence on the hereditary constitution of the plant, being apparently devoid of genes, and these considerations lead the author to regard them not as true chromosomes but at the most as some sort of " chromosomal bodies " or fragments. This excludes the possibility of their origin by duplication of existing chromosomes, none of which, incidentally, do they resemble. No other plant possessing chromosomes of this type is known and their introduction through hybridization is thought highly improbable.
Cases are mentioned of elimination of sections of or of whole chromosomes and of impoverishment of the hereditary substance of a chromosome and it is suggested that the latter may ultimately be the cause of the former. In *Zea* the inactivation of certain chromosomes or sections of chromosomes has supposedly led to these breaking away, being completely eliminated in the majority of forms, but retained in a few. The larger numbers of supernumerary chromosomes have probably resulted from the irregular distribution of these " fragments " at meiosis, increases in the number of supernumerary chromosomes having been observed in crosses between forms possessing them.
Morphological distinctions were observed in all 10 chromosome pairs also in *Euchlaena mexicana*, the types being exactly the same as in *Zea* ; the whole karyotype was apparently the same as the maize one, except that certain individuals had one of the two type VII chromosomes smaller than the other, and it is pointed out that this may possibly result in failure of conjugation when such types are crossed with maize.
The identity of the two idiograms indicates that the evolution of the karyotype preceded the separation of the two genera.

157. MARSTON, A. R. 633.15–2.7–1.521.6:575
Recent progress in breeding borer resistant corn.
Quart. Bull. Mich. Agric. Expt. Sta. 1933 : **15** : 264–68.
The progeny of crosses between Maize Amargo, a low-yielding South American corn markedly resistant to European corn borer attack, and native Michigan varieties have been inbred and selected for resistance for several years and a low degree of borer infestation has been obtained,

though not without loss of vigour. In order to counteract this latter defect by the effects of heterosis, inbred resistant lines were interbred either as single crosses, double crosses or by blending pollen of several inbred strains to produce a synthetic strain. This method has been successful in restoring vigour and productivity in most cases while at the same time retaining the reduced borer infestation.
To avoid the necessity of continually planting first generation seed each year, an attempt is being made by blending inbred strains to develop a type which would continue to give nearly its maximum yield from seed selected from the blend generation after generation. Several synthetic lines containing large numbers of inbred ♂ and ♀ parents have been produced.
Further selection and tests are needed before highly resistant and productive lines are available for commercial purposes.

BARLEY 633.16

158. *Beneš, V. 633.16:575(43.72)
Zušlechtovací práce s ječmenem šlechtitelské sekce zemského výzkumného ústavu zemědělského v Brně. (**Breeding barley for improvement at the plant breeding section of the Provincial Agricultural Research Institute at Brünn.**)
Českoslov. Zeměd. 1933 : **49** :
A report on attempts to improve local varieties of Moravian barley by (a) hybridization and (b) selection.
In 1922 various crosses were begun between Hanak VIII, IX, large grained RV and Jarohnovice (a variety with a relatively firm straw but with greyish grain) with the object of producing a strain of good quality, yield and colour of grain, early and resistant to lodging, drought and stripe disease. No constant form of the required type was obtained even in F_4.
On the other hand selection begun in 1921 with 7 local varieties chosen by ear selection direct from the growers, resulted in the isolation of a valuable strain, now recognized as a variety, Pisarek R 31, and possessing almost all the desired characteristics. It yielded on an average 33.88 quintals per hectare for 4 years, had a percentage of 94·03 of high quality grain and in 1925 proved resistant to drought and gave a satisfactory yield.

159. Euler, H. v. and Bergman, B. 633.16:575.061.634:581.174
Chromatophoren-Degeneration in Laubblättern von chlorophylldefekten Gersten-Mutanten. (**Chloroplast degeneration in the leaves of chlorophyll defective mutants of barley.**)
Ber. deuts. bot. Ges. 1933 : **51** : 283–90.
An examination of the Albina types 1, 2, 3 and 7 shewed that the chloroplasts of 1 and of 7 resembled each other in being small, round to oval in shape and having as a rule, one white spot or vacuole in each. The chloroplasts of Albina 2 and 3 also resembled each other but differed from 1 and 7 in their irregular angular shapes and in the absence of vacuoles.
In the Xantha forms 1 and 2 the chloroplasts were not obviously degenerated as in the Albina types but they were blunt angled and irregular in shape. In Xantha 3 they were rounded but smaller and as in the two preceding types there were no visible vacuoles.
In Alboxantha the chloroplasts are few but very large, rounded and with 6–7 vacuoles and probably represent a fusion of small chloroplasts.
It is concluded that the gene causing chlorophyll deficiency acts not directly on the chlorophyll molecule but on the plastid.

160. Daane, A. 633.16:575.116.1
Linkage relations in barley.
Tech. Bull. Minn. Agric. Expt. Sta. 1931 : No. 78 : Pp. 30.
A six-rowed barley (*H. vulgare*) was reciprocally crossed with three other types and the following eight characters and their linkage relations were studied in the resulting progeny : type of spike,

* A full translation of this paper is on file at the Bureau.

of awn and of rachilla, colour of glumes and of pericarp, glume extension, covering of caryopsis and character of chlorophyll.
A single factor difference between the contrasting pairs of characters was shewn by the F_2 progeny.
Linkage was found between normal versus virescent seedlings and non-six-rowed versus six-rowed with a crossing-over percentage of about 27 per cent and between purple versus white pericarp and normal versus virescent seedlings with a crossing-over percentage of about 17·90. Linkage was also found between long versus short haired rachilla and rough versus smooth awns with about 28 per cent of crossing over.

161. EULER, H. v., BURSTRÖM, D. and HELLSTRÖM, H. 633.16:575.242.061.6:581.192.2
Über die Konstanz des Chlorophyllgehaltes in drei Chlorophyllmutanten. (**The constancy of the chlorophyll content of three chlorophyll mutants.**)
Hereditas 1933 : **18** : 225–44.
The present material was chosen for a study of the chemical nature of a mutating character and to begin with it was necessary to study the constancy or degree of variation of the mutating character, viz. the chlorophyll concentration, a character on which variation experiments have as yet not been carried out.
The chlorophyll content of 100 normal plants of a line of Golden Barley (Gullkorn) was measured, and similarly for Xantha 1 and 2 and Albina 1 ; the standard deviations for the chlorophyll content were calculated and graphical representations of the variation are also presented.
The Albina mutants proved to be entirely devoid of chlorophyll, as well as of carotin and xanthophyll, the chloroplasts being either absent or defective. There can, therefore, be no question as to the absolute dominance of green where this character is concerned. The chlorophyll content of the Xantha type was 1/3 that of the normals.
The catalase content of the Albina was 1/3 that of the normals, in the Xantha type unchanged.

162. 633.16:581.46:575.11
MIÈGE, E. 633.16:581.162.32
Réapparition par hybridation spontanée, d'une espèce d'*Hordeum*. (*H. intermedium* KCK.) [**Reappearance by out-pollination of a species of *Hordeum*. (*H. intermedium* Kck.)**]
C. R. Acad. Sci. Paris 1933 : **197** : 185–87.
A peculiar 2-rowed barley appeared in a pure line of *H. tetrastichum* Kck. var. *pallidum*. Its progeny contained 2 and 4-rowed plants together with various peculiar forms, *H. muticum distichum* Att., *H. rostratum* Att. and *H. rostratum vulgare* Att. (*H. intermedium Haxtoni* Kck.) In F_3 the 2 and 4-rowed plants bred true and the intermediums segregated as before, giving certain new types in addition, including *deficiens*.
This behaviour and the brittleness of the rachis of the hybrid plant, are regarded as indicating that the plant originated by natural hybridization between 2 and many-rowed barleys. Several other similar cases were observed also for the first time in 1933. The results also confirm the hybrid nature of *H. intermedium*.

MILLETS AND SORGHUMS 633.17

163. KARPER, R. E. 633.174:575.061.5:581.483
Inheritance of waxy endosperm in sorghum.
J. Hered. 1933 : **24** : 257–62.
Plants with waxy endosperm staining red with iodine were obtained from the Philippine Islands and were crossed reciprocally with varieties of kafir and milo with starchy endosperm.
The endosperm of the F_1 seeds stained blue with iodine, the first case of xenia recorded in sorghum.
Segregation of the pollen into grains staining red or blue with iodine in about equal proportion was observed in the heterozygous plants. The character behaves as a single recessive to the normal starchy endosperm.

The Mendelian segregation of endosperm characters in the seeds of a single heterozygous plant suggests that gametogenesis takes place as in maize, the embryo sac originating from a single megaspore.
It is noteworthy that waxy endosperm which has been reported in rice, maize, Coix and millet is apparently confined to plants of Asiatic origin.

164. 633.174–2.451.2:575.12
RODENHISER, H. A. and BARNES, B. F. 633.174–2.451.2:576.16:575.12
Pathogenicity of certain hybrids of covered and loose smuts of sorghum.
Phytopathology 1933 : **23** : 30–31. (Abst.).
Intraspecific crosses of physiological forms 1 and 2 and of 1 and 3 of *Sphacelotheca sorghi* were made and also interspecific hybrids of form 2 and of form 3 respectively with *S. cruenta*.
On the susceptible Reed kafir variety the intraspecific crosses were more virulent than the inbred lines of either parental form, while the latter in their turn were more virulent than the interspecific hybrids. In general, on the sorghum varieties susceptible to one inbred parent and resistant to the other, both intra- and interspecific F_1 chlamydospores proved to be intermediate in their virulence. On kafir x feterita (H.C. 2423), the interspecific hybrid arising from a cross of form 3 of *S. sorghi* with *S. cruenta* was only slightly less virulent than either parent. Spur feterita (C. I. 623) was immune in all the pathogenicity tests.

RICE 633.18

165. PIACCO, R. 633.18
Un riso selvatico. **(A wild rice).**
G. Risicolt. 1933 : **23** : 135–39.
A variety of rice which grows wild in India is described. The seeds were found to lose their power of germination when kept from one season to the next ; and of the crosses made with various cultivated varieties all except that with Lady Wright were practically sterile. The hybrids of the successful cross are under observation.

166. DUMONT, R. 633.18:575
Genetic improvement and fertilization of rice in Italy, Ceylon and Indo-china : The statistical method and comparative trials in the field.
Int. Rev. Agric. Rome 1933 : **24** : 195–220.
A visit by the director of the Station for Rice Cultivation, Tonkin, to various rice growing stations in Italy and India has provided the subject matter for this paper.
Italy : Bologna.
Breeding is concentrated on the production of comparatively early maturing varieties, resistant to lodging, disease and shedding, and capable of yielding fine milling rice of the " Lady Wright " type, a variety greatly used for hybridization at Bologna and Vercelli. Yield is regarded as relatively unimportant, though it is recognised that early maturity and high yield can be combined. A long translucent grain and dark coloured nodes, glumes, etc. are wanted as pigmentation is thought to be correlated with good grain quality. No morphological characters correlated with disease resistance have yet been discovered. Originario, rejected in favour of " Americano 1600 " owing to its susceptibility to disease, has a somewhat extensive opaque zone—a genetic character.
The methods of pure line selection and of laying out the plots are described. Details are given of the technique of breeding. Appearance, hardness of grain, breakage, resistance to lodging and disease are observed throughout the different generations. Natural crossing has been observed. Wild and cultivated varieties have been crossed at Vercelli, on account of the vigour of the wild form and its resistance to blast, but owing to the low productivity of wild rice and the dominance of most of its characteristics a long time is needed to obtain a fixed homozygote.
The acclimatization of a number of foreign varieties in Italian soil is discussed.

The work on the heritable changes produced by magnetic action, light, etc. (cf. " Plant Breeding Abstracts," Vol. III, Abst. 172) and fertilizer and pot experiments are briefly mentioned.

India.

A collection of the varieties grown in Madras was made and 800 varieties are now grown at the Central Station of Coimbatore where the most common varieties are used for breeding work, the less common types being investigated at the local sub-stations. Pure line selection and selection by elimination of unsuitable types on the basis of genetical, physiological and morphological investigations in the field and in the laboratory are practised. Varieties from other regions of India and foreign countries are of interest mainly as material for crossing. In addition to the classical method of emasculation another very rapid method in which the opening of the glumes is hastened by wrapping the panicles in dark paper is used.

The general breeding technique is described.

Ceylon.

Improvement by genetic selection is carried out mainly at the four chief stations. The method of isolating lines is fully described.

Yield and other characters of individual strains are noted and subsequently 5 or 6 of the best are retained and sent to the sub-stations for comparative tests of yields in the environment in which it is hoped to cultivate the selected seeds. The method used in the comparative yield tests is outlined.

Before being entrusted to growers for cultivation the best lines are first tested for their adaptation to different conditions, though the yield of rice in Ceylon is normally comparatively low, 6–8 quintals per hectare. Selection is nevertheless carried out on well cultivated soil since methods of cultivation may improve in the future.

Since 1929 a comparative study of the yield from pure lines cultivated alone and as mixtures has shewn that the mixing has no effect on the yield.

Fertilizer trials are also described.

Indochina.

A preliminary analysis of the soils of Indochina is in progress and should determine which regions are ecologically important for rice growing. Experimental fields for fertilizers and varieties are to be established for the various regions.

A complete survey has been made of all varieties now cultivated in Indochina and the samples collected have been tested and the ecological zones provisionally marked out. The good and bad points of the varieties are noted during growth and morphological descriptions are drawn up and completed by a study of the grain and kernel from the botanical and technological aspects. Comparative yield studies under the various normal environments of the varieties are in progress, and genetic studies of promising material are being made.

Much attention is given to fertilizer trials and the underlying statistical theory which also bears on breeding problems is fully discussed.

With reference to the technique of genetic research the question of pure lines and their reaction in different environments is mentioned, and it is concluded that in the case of selected seed for sowing in the field mixtures of closely related lines should be used as being more adaptable ; pure lines should, however, be used as a basis of systematic morphological descriptions of varieties.

A study of the relative effects of environment and of variety on the morphological characteristics of rice is needed. Moreover, the problem of acclimatization should not be neglected.

Though the greater part of the research on varieties and fertilizers must be carried out in various natural regions, it is suggested that a Central Research Station should be formed for each great rice growing country (Cochinchina, Tonkin) where genetic and biological problems and the improvement of cultural methods could be investigated.

The general work of improvement necessitates co-operation with the growers and their economic problems must be considered.

167. NAGAI, I. 633.18:575.061.6:581.45

(The number of leaf-stomata in relation to a spot-leaved mutant in rice.)

Ann. Agric. Exp. Sta. Gov.–Gen. Chosen (Tyôsen) 1932 : **6** : 345–46.

A recessive variegated mutant of paddy rice segregated out from a Corean race, the ratio being 3 normals to 1 variegated. The difference in the number of stomata on the upper surface of the leaf in the 2 races was 68·27 ± 13·3 and on the lower surface 63·62 ± 11·53, the mutant having the greater number of stomata.

168. 633.18:575.12

SAMPIETRO, G. 633.18:581.162.3:578.08

Fécondation naturelle et hybridation artificielle du riz. (**Natural and artificial crossing in rice.**)

Riz et Rizicult. 1933 : **7** : 109–14.

The structure of the rice flower and the general physiology of the process of fertilization are described. All flowers on a panicle are not fertilized on the same day; and in certain varieties 5 to 6 or even 10 days elapse before the whole panicle is pollinated. The hours when fertilization occurs, the requisite temperature and the atmospheric moisture content and other favourable environmental conditions, in addition to the process of embryonic development, are briefly touched on.

The practical aspect of emasculation, pollination and bagging is given in detail, 30 being the normal percentage of success.

169. MEULEN, J. G. J. VAN DER 633.18:575.12:578.08

Over het kunstmatig kruisen van rijst op Java. (**Artificial crossing of rice in Java.**)

Korte Meded. Algemeen Proefst. Landb. Buitenz. 1933 : No. 13 : Pp. 23.

A comprehensive paper opening with the morphology and biology of the rice flower and a survey of the findings of previous workers on the problems and technique of hybridization. In general self-pollination is the usual method of fertilization but cross-pollination may occur.

The methods and various degrees of success obtained in the author's own experiments with starchy types of rice from 1928 to 1931 are given in detail. In 1930 the following technique applied in six combinations yielded from 0—68 per cent seed and 25—94 per cent of plants of which 95—100 per cent were hybrids :—

Between 9 and 10 a.m. a very small portion of the pales was clipped off, the flower gently squeezed between forceps at its widest diameter and through the opening thus formed the stamens were removed. The pollen was obtained from panicles taken from the ♂ parent that had been in bloom for one or two days. The panicles were kept in water in the shade, and as the flowers opened functioning anthers were removed with forceps and either placed in the emasculated flowers or shaken out over them. The pollinated panicle was then bagged.

By utilizing the fact that when in the shade a number of flowers open some time before the pollen is shed, the extruded filaments can be removed between 7 and 9 a.m. Twenty-three flowers thus emasculated gave 18 well developed seeds 14 of which yielded hybrids. This method gave better results than the previous one, except for the fact that the percentages of hybrids obtained ranged from 75—100. On the other hand the small numbers used in the test and the fact that one is dependent on a small number of flowers that may happen to open must be considered in estimating the value of this method.

In September, 1931, the technique was further improved by using a very slightly modified form of Kirk's method of emasculation by sucking away the stamens and pollen with a fine glass nozzle attached to a water jet vacuum pump after $\frac{1}{4}$—$\frac{1}{3}$ of the pales had been clipped off. Full particulars of the apparatus and its use are given. Emasculation by this means gave from 1188 crosses 712 seeds which produced 501 plants of which 491 were hybrids.

This combined technique is also rapid, for one person between 7 and 12 a.m. can make 100—150 crosses comprising 3 combinations as compared with 25—50 crosses of one combination by the old method.

Incidentally the most favourable interval after emasculation for pollination was investigated and the results though inconclusive suggest that the percentage of seed set might be increased by attention to this point.

170. 633.18:575.242:581.162.5
ISSHIKI, S. 633.18:575.255
(On the occurrence and inheritance of sterile rice plants with twisted leaves and narrow leaved ones with open glumes).
Proc. Crop Sci. Soc. Japan 1933 : **5** : 192–203.
In a strain of rice " sosei " No. 16 a recessive type occurred which was characterized by sterility, absence of median ribs in the leaves, twisted leaf base, abnormal branching, pistil degenerated into the form of a leaf and the occurrence of earing twice in a season. On crossing with the normal form the progeny shewed a 3 : 1 ratio of normals to sterile type. Some of the normals were chimaeras of normal and abnormal portions, attributed to a recessive mutation of some of the primordial cells of a normal individual. The normal portions bred true to normal, the abnormal portions were sterile.
A second recessive aberrant type found in " Asahi " was termed " narrow-leaved open glume " type. Apparently the leaf defect was due to a reduction in the number of veins, while the open glume was caused by loss of capacity to close the glumes after flowering. This type also gave a 3 : 1 ratio of normals to abnormals in F_2 for the glume character.

171. CHIAPPELLI, R. 633.18:575.42
Selezioniamo i risi ! **(Let us select rice.)**
G. Risicolt. 1933 : **23** : 157–59.
The methods of mass selection, advocated for the production of pure seed, are described and the best varieties for selection, for export or home consumption are named.

172. NAKAMURA, E. 633.18:576.356.5
(The occurrence of triploids in rice plants.)
Jap. J. Genet. 1933 : **8** : p. 228.
A preliminary note on a number of triploid rice plants observed in 1930. All were of similar appearance, i.e., with broader leaves, stouter stems and larger grains than the normal ; some had also short beards. The chromosome number is 36 and triploidy is therefore provisionally assumed until the cytological investigation has been completed.

173. NAKAMURA, S. 633.18:576.356.52
(Haploidy in the rice plant.)
Jap. J. Genet. 1933 : **8** : 223–27.
The occurrence of 2 haploid rice plants of presumed parthenogenetic origin is recorded. They were 1·5 to 3 times shorter and slenderer than the diploid form. The somatic chromosome number was found to be 12 and in gamete formation reduction was omitted, and all 12 chromosomes gathered at one pole when a functional pollen grain was formed.
The haploid plant though incapable of flowering frequently exhibits parthenocarpy (ca. 50%). Also, in spite of a high degree of sterility, self-fertilization or fertilization by a diploid occasionally results in grain formation. The progeny are then all diploid and homozygous.

174. ENOMOTO, N. 633.18:581.036:581.162.5
(Fertilization of rice plants as influenced by low temperatures about the period of flowering).
Proc. Crop Sci. Soc. Japan 1933 : **5** : 216–42.
Plants of the " sosei " variety of rice were subjected during earing and flowering to temperatures ranging from 16·5°C. to 17°C., and also closed flowers after the flowering period were exposed to temperatures of 16·5°C.—17°C. for 36—72 hours and a temperature of 18°C. for 48—96 hours. In no case was fertility affected.
With a temperature of 18°C. before the flowering period no flowers had opened even 2 days later, though fertility was unimpaired ; some flowers, however, opened after 4 days at this temperature. A temperature of 21°C. applied for 4 days resulted in the opening of many more flowers than with a temperature of 18°C. Flowers which opened during this low temperature treatment shewed greatly impaired fertility, 18°C. being more injurious than 21°C.

175. MAGRUDER, R. 633.41:581.162.31:578.08
The effect of kind of paper bags on the production of selfed table beet seed under bags.
Proc. Amer. Soc. Hort. Sci. 1932 : 29 : 442–44.

Judged on the basis of percentage of seed set and percentage of germinable seed, Tiger Kraft paper bags proved superior to the glassine and parchment bags tested. The Tiger Kraft type, however, tended to disintegrate somewhat earlier than other types.

176. RASMUSSON, J. 633.41:581.9
Några iakttagelser över *Beta maritima* L. (**Some observations on *Beta maritima* L.**)
Bot. Notiser 1933 : 316–24.

A study of the possible source and distribution of *B. maritima* on the coast of Scania (Sweden). Observations shewed that seed of this plant, probably from Zealand, does in fact reach the west coast of Scania and grows there ; and its sporadic occurrence is due mainly to the fact that either it is not thrown up out of reach of the sea or else it is unable to survive above high-water mark in the existing conditions of soil and climate.
Certain localities in Great Britain where *B. maritima* was found along the sea coast either in large numbers or as isolated specimens were also visited ; and in the eastern parts of the south coast and in the Isle of Wight populations were found resembling those found in Kalundborg (Zealand) except for certain differences in the degree of pigmentation of the stem and for the growth habit, the neck of the Isle of Wight root being less deeply buried in the ground—a characteristic which may be due either to soil difference or a genetic adaptation.
At Minnis Bay (near Margate) a population was discovered resembling that found at Gisselöre and like it too in that some specimens have adopted the upright habit. From the presence nearby of a large population of erect and deeply pigmented beets, it seemed possible that the Minnis Bay beets represent a segregating population from a cross of *B. maritima* and cultivated beets, though the possible origin of the latter ancestors remains unexplained.
Near Holyhead a type of beet was found differing in size and foliage from the Kalundborg form. On the Bass Rock where *B. maritima* has long been known a large population was discovered near and even actually in the walls of an ancient castle. Though exhibiting considerable uniformity these beets differed from the Kalundborg type in foliage and in their less markedly prostrate habit. Whether they represent a population that has reverted to the wild state or actually a wild population that has become established on the Rock is so far unknown.

177. TERASAWA, Y. 633.42:575.127
(**Crossing between *Brassico-raphanus* and *B. chinensis* and *Raphanus sativus* L.**)
Jap. J. Genet. 1933 : 8 : 229–30.

A brief report of crosses involving *Brassico-raphanus* ♀ and the following as the ♂ parents : *Raphanus sativus*, *Brassica oleracea* L., *B. chinensis*, L., *B. pekinensis*, *B. cernua*, *B. Napus* and *Brassico-raphanus*.
B. chinensis L. and *R. sativus* crossed with *Brassico-raphanus* only with difficulty, whilst *Brassica Napus* on the other hand crossed with ease. The attempted cross with *B. oleracea* gave no progeny ; but the pollinations with the remaining varieties gave satisfactory numbers.
Observations on the hybrids of *Brassico-raphanus* with *B. chinensis* L., *B. pekinensis* Pupr., *B. cernua* Hemsl. and *B. Napus* seem to indicate that the F_1 plants are on the whole of intermediate type, though individual differences in fertility have been noted.

178. MORINAGA, T. 633.42:575.127.2:576.356.7
Interspecific hybridization in *Brassica* V. The cytology of F_1 hybrid of *B. carinata* and *B. alboglabra*
Jap. J. Bot. 1933 : **6** : 467–75.
B. alboglabra (n = 9) has the same chromosome number as *B. oleracea*, with which it crosses with perfect ease. Its hybrid with *B. carinata* (n = 17) succeeded only when the latter was used as female and then only 1 germinable seed was obtained from 36 flowers. The hybrid displayed considerable heterosis, was sterile when bagged but by open pollination produced a few seeds. All heterotypic metaphases observed contained 25 chromosomes, 9 bivalents and 7 univalents. The univalents split and pass to the poles later than the bivalents ; 29 per cent of the homeotypic spindles contained all 16 chromosomes, but 15 were in 55 per cent of the spindles, indicating loss of a univalent, whilst occasionally 17 were counted. Lagging chromosomes often failed to be included in the nucleus at anaphase I.
The hybrid of *B. carinata* with *Raphanus* forms no bivalents and the 9 bivalents formed by the present hybrid, just as by hybrid *B. carinata* x *B. oleracea*, are attributed to allosyndesis. The remaining chromosome set in *B. carinata* must consist therefore of 8 chromosomes, 1 of these has possibly been lost in the hybrid under investigation, which should otherwise have had 26 chromosomes.
The bivalents which *B. carinata* forms with *B. chinensis* and with *Raphanus* are not so firmly paired as those formed in the present hybrid.

179. 633.42:575.127.5:635.15:576.312.35
TERASAWA, Y. 575.127.5:581.47:576.312.35
(On the form of fruits of the hybrid plant between *Brassica* and *Raphanus*.)
Proc. Crop Sci. Soc. Japan 1933 : **5** : 107–15.
A confirmation of Karpechenko's findings on *Brassica-Raphanus* hybrids on the correlation between the ratios for the lengths of the indehiscent and dehiscent portions of the fruit on the one hand and the ratios between the total number of chromosomes and the contributions from the parent species on the other.
Crosses of *B. chinensis* L. (2n = 20) and *R. sativus* L. (2n = 18) were made and in F_4 a constant *Brassico-raphanus* amphidiploid (2n = 38) was obtained. Hybrids of *Brassico-raphanus* ♀ x *B. Napus* ♂ were also used. In F_1 the ratio for the degree of dehiscence and also the ratio of the total number of chromosomes and the number of *Brassica* chromosomes were approximately intermediate between the corresponding ratios for the parent types. Similar data were obtained from *Brassico-raphanus* and the *Brassico-raphanus* x *B. Napus* cross.

180. 633.42:581.331.2.095:576.16
SHISA, M. 633.42:581.142.095
(Investigation of pollen-germination of *Brassica* and its application to discrimination of species.)
Jap. J. Genet. 1933 : **8** : 204–06.
The pollen of various species of *Brassica* exhibits a differential response in the degree of germination when grown on isinglass and gelatin media respectively.
Various species are classified according to this reaction which has also been studied in relation to chromosome size, and it is claimed that the method may be used as an aid in the systematic identification of *Brassica* pollens.

181. *KOČNAR, K. and ŠMERDA, V. 633.425:581.141
Výsledky pokusů se zeleninou v r. 1929–1931. **(Results of experiments with various species of vegetables in 1929-1931.)**
Sbor. (Annals) Českoslov. Akad. Zeměd. 1932 : **7** : 217–44.
The process of flowering and setting of the siliques in kohl-rabi is outlined. An investigation of the possible relationship between the set in the siliques and the value of the seed shewed that

* Translation of pages 222-26 on file at the Bureau.

the position and time of flowering of the blossom were not related to quantity or quality of seed. It was, however, found that the poorest seeds from the standpoint of quality and quantity were those growing close to the stalk of the flower ; the best were situated in the middle of the silique. After germination this difference in the seed from the various parts of the silique was no longer present. Germination capacity was found to increase in direct proportion to the weight of the seed.
An abnormal silique with two septa both with seeds was found in the material examined. The possible inheritance of this phenomenon is to be investigated.

182. STEVENSON, F. J. 633.491:575(73)
Potato breeding.
Rep. Md. Agric. Soc. 1932 : **17** : 344–49.
Potato breeding work in the United States is organized on a basis of co-operation between the United States Department of Agriculture and certain State experiment stations. At present attempts are being made to combine resistance to mild mosaic, late blight, scab, and Fusarium wilt with other important characters such as yield, shape, depth of eye and desirable cooking quality.
New varieties have been produced, some of which are resistant to mild mosaic, others resistant to late blight, and at least one which has been found resistant to common scab. Among those resistant to mild mosaic are Katahdin, a high yielding, smooth, shallow-eyed potato, and another similar but earlier seedling from the same parents. A cross of these two seedlings has given a number of seedlings resistant to mild mosaic and commercially promising types.
A few seedlings among several progenies tested for late blight resistance also gave encouraging results.
In 1931-32 varieties from South America were obtained for hybridization work. Some of those from the higher altitudes of Peru and Bolivia may possibly prove frost resistant.

183. STEVENSON, F. J. and CLARK, C. F. 633.491:575:578.082
Artificial light as an aid in potato breeding.
Amer. Pot. J. 1933 : **10** : 103–07.
Having briefly reviewed the known facts about sterility in potatoes and the effects of environment in producing this condition an experiment carried out in Virginia in 1931–32 is described. The objects were to study the effects of the intensity of light on growth, flowering and tuber production and to obtain cytological material of several strains and to obtain seed. The period of exposure to artificial light was from 5.30 to 11.30 p.m. daily from February 11th to April 12th and the strength of illumination was 1,000 watts for one group and 500 watts for the second group. The application of artificial light apparently stimulated plant growth and flowering to a remarkable degree, but tuber production scarcely at all. There was a high correlation between the capacity for setting seed by natural fertilization in the field and the number of flowers produced in the greenhouse under lights.
In three out of six strains examined the pollen was scanty and in the remaining three more plentiful. No naturally fertilized seed was produced but inbred seed was readily obtained under the lights by hand-pollination of self-fertile plants.
Fruits but no seed resulted from an attempted cross between a variety with the haploid number 12 and several cultivated varieties in which the haploid number was 24.

184. OPPENHEIMER, H. C. 633.491:575.127.2:576.356
Cytogenetische Untersuchungen an Bastarden knollentragender *Solanum*-Arten. I. *Solanum chacoense* Bitt. x *Solanum tuberosum* L. s. str. **(Cytogenetic investigations on tuber-bearing hybrids of *Solanum* species, I *Solanum chacoense* Bitt. x *Solanum tuberosum* L. s. str.)**
Z. indukt. Abstamm.– u. VererbLehre. 1933 : **65** : 72–98.
The material for the investigation consisted of the two parent plants *Solanum chacoense* ♀ and *S. tuberosum* (Chiloe)♂, four F_1 plants, seed from three selfed F_1 plants, and from back-crosses of the same three with *S. tuberosum*. The reciprocal of the parent cross could not be obtained. Anthers, root tips and ovaries were examined.

The origins and morphological characteristics of the P_1 plants are described. *S. chacoense*, which is self-sterile, has 24 somatic chromosomes and exhibited only one anomaly, a case of dyad formation, in meiosis. *S. tuberosum* L. (Chiloe) is self-fertile and has 48 as the somatic complement. As far as could be judged from the limited material available no abnormalities of division occurred.

The F_1 gave one plant (29·39/2) in which 2n was definitely known to be 36, and possibly two others with the same number. In plant No. 29·39/2 most of the characteristics of *S. tuberosum* were dominant. The dark leaf colour and red stalk are possibly the results of combination. The flower is apparently sterile. Various anomalies were observed in the maturation division; and it seems that 12 *tuberosum* chromosomes pair with 12 *chacoense* chromosomes leaving the remaining 12 *tuberosum* chromosomes unpaired; though the possibility of pairing between *tuberosum* chromosomes *inter se* with consequent univalency in the *chacoense* chromosomes cannot be excluded since no case of the failure of pairing in a haploid di-basic *S. tuberosum* plant has yet been demonstrated. The second maturation division was regular and is regarded as confirming the fact that the pairing in the first division is as above described. No progeny has yet been obtained from plant 29.39/2. In considering the work of Vilmorin on *Solanum Commersonii*, and of Salaman on the *S. utile* (a diploid hexabasic form) x *S. tuberosum* cross, the question of the failure of certain reciprocal crosses is touched upon, and the author tentatively suggests that the effect of differences in the length of the style upon penetration by the pollen from *S. chacoense* may explain the failure of this cross in his experiments. An alternative explanation is the possibility of the existence of a sterility allelomorph in one of the *S. tuberosum* genoms corresponding to *S. chacoense*. A second type in the F_1 was presumably tetra-basic with the chromosome number of the ♂ parent (2n = 48), a fact which the author explains on the grounds of external morphological resemblance and similarity of habit as being most likely due to the fertilization of a diploid ovum of *S. chacoense* by normal haploid pollen of *S. tuberosum*, since this type of F_1 plants resembled the *S. chacoense* more closely than did the tri-basic F_1. The method of chromosome pairing was in the author's opinion more likely autosyndetic than allosyndetic.

The anomaly of fusion of the two metaphase plates of the second division with consequent dyad formation was quite clearly seen in one of the three tetra-basic plants and some of its progeny. This phenomenon was not observed in *S. tuberosum*, and its potential occurrence in *S. chacoense* can only be deduced from the dyad in the *S. chacoense* material. Hence its hereditary origin in the F_1 plant is unexplained. The tetra-basic F_1 plants were highly fertile although from their assumed origin they probably contain two genoms of the self-sterile *S. chacoense*. The genetical basis of these F_1's is obscure but it seems likely that there are no self-sterile plants in F_2 and that the difficulties of obtaining seed are physiological or cytological in nature.

On selfing, the three tetra-basic F_1 plants yielded 2,200 plants so extremely varied that classification of certain characteristics was impossible. The colour ratios, however (as determined from part of the material) shewed 113 like *tubersom* and 339 like *chacoense*, a reversal of dominance due to the presence of two *chacoense* genoms in F_1. In tuber shape too dominance was reversed, the ratio being 260 round to 192 long. In clones of F_2 the white and round characters of *chacoense* were clearly dominant to the red and long of *tuberosum*. The chromosome number (as determined from part of the F_2 material) was 44–52 in root tips; and in 49 F_2 plants from free pollination 46–50 chromosomes were found in 14 plants; so that fertility is not affected in somewhat hypo- or hyper-tetra-basic plants.

The back-crosses were morphologically so varied that no grouping was possible though again the *S. tuberosum* characters markedly preponderated. Cytological examination again shewed that F_1 gametes containing 22 and 26 chromosomes are in all probability functional.

Further work with some of the material used is to be continued.

185. 633.491:576.356
633.491:576.312.35

*Rybin, V. A.

(Cytological investigation of the South American cultivated and wild potatoes, and its significance for plant breeding.)

Bull. Appl. Bot. Leningrad 1933: Ser. 2 (2): 3–100.

* An abridged translation of this work is on file at the Bureau.

Investigations have been made (1) on the chromosome number of a number of indigenous cultivated species not studied in 1928 ; (2) on the chromosome number of a number of wild potatoes received recently ; (3) on the reduction division of a considerable number of wild and cultivated South American potatoes of various chromosome groups ; and (4) on the reduction division in a number of artificial hybrids, between species of the same and different chromosome numbers. The existence of species with 24, 36, 48, 60 and 72 chromosomes in both wild and cultivated groups is confirmed.
Many of the species formerly regarded as wild progenitors of the cultivated potato have proved to be triploid, pentaploid or hexaploid, which accounts for the failure of the earlier attempts to cross them with the cultivated potato.
Hybrids with the wild species having 48 chromosomes are produced perfectly easily however ; they are completely fertile and meiosis is entirely regular. Even in hybrids between species differing in chromosome number those chromosomes for which there are partners form gemini, indicating considerable homology between the chromosomes of different *Solanum* species.
Many of the chromosome irregularities characteristic of the cultivated potato, including the tendency to form unreduced pollen grains, which however are apparently never functional, have also been observed in wild species, especially the Chilean species such as *S. Antipoviczii*.
A new method whereby permanent preparations of aceto-carmine smears can be made is described.
There follow detailed descriptions of meiosis in the various species and hybrids. Meiosis in all the 36 chromosome species was highly irregular, similarly in the 60 chromosome group ; the 48 chromosome group on the other hand displayed great regularity in meiosis, with 24 bivalents at metaphase I, and meiosis in the 24 chromosome species was perfectly regular with an invariable haploid number 12 at both reduction divisions.

186. Reddick, D. and Crosier, W. 633.491–2.411.4:576.16
Biological specialization in *Phytophthora infestans*.
Amer. Pot. J. 1933 : **10** : 129–34.

Tubers of plants exhibiting different degrees of resistance were distributed to workers in different parts of the world and so far the results have given no indication of the existence of physiological specialization.
Attention however is called to the fact that oospores have recently been observed in cultures of the fungus in Holland and that results of Schick indicate the existence of 3 physiological forms ; it is not impossible that these 2 facts may be connected.
The similarity in behaviour of the W races and *Solanum demissum* suggests that the W races are hybrids of this species.
Tests of the fungus from different parts of North America continue to indicate the existence there of not more than one form.

187. Kattermann, G. and Wenk, H. 633.491–2.411.4:576.16(43.3)
Ein neuer Phytophthorabiotyp auch in Bayern ? (**A new biotype of phytophthora also in Bavaria ?**)
Züchter 1933 : **5** : 129–32.

The new biotype of *Phythophthora infestans* is apparently no longer confined to Streckenthin (Cf. " Plant Breeding Abstracts," Vol. III, Abst. 236) for it now appears to have gained a footing in Bavaria, at Weihanstephan and at Schönach where it has wrought much havoc in the seedlings obtained after five years of careful breeding with two highly resistant strains P1 and P6 obtained from the Biologische Reichsanstalt in 1927 for crossing.
It is definitely known that the P. races and also a large number of seedlings and clones obtained by crossing were highly resistant up to the beginning of the vegetative period in 1932 ; but in August of that year the P. races and their progeny all shewed severe infection. Then in the spring of 1933 when inoculation tests were being made not one out of 300 clones tested was resistant to the new fungus obtained from the tubers of the P6 race. Also P1 and P6 and the clones that had been healthy in the autumn were just as severely infected as the varieties formerly known to be susceptible.
Reasons are given for believing that the new biotype has been imported from Streckenthin and

may be identical with Schick's Streckenthin type. The mode of origin of the new biotype is rather doubtful, either mutation or recombination being possible causes. Future work on resistance will be rendered exceedingly difficult though not impossible by the discovery of the new forms.

188. SCHMIDT, E. 633.491–2.411.4–1.521.6:575
Unsere Erfahrungen bei der Züchtung phytophthoraresistenter Kartoffeln.
(Our experiences in breeding phytophthora resistant potatoes).
Züchter 1933 : **5** : 173–79.

Reference is made to tests carried out at Streckenthin on 5,000 seedlings obtained from Müller's SW races by selfing and crossing with common cultivated varieties, on the SW races themselves and on hybrids of a cross of Polanin with the so-called Ef strains which also originated from a wild American form crossed with cultivated potatoes. The Ef strains were the only ones which proved resistant in both field tests and artificial infections.

In 1926 crosses of the Ef strains with the varieties Pepo, Centifolia and Alma gave about 50 per cent resistant seedlings, which were retained and again crossed with cultivated varieties. This process was repeated three times and in 1932 a total of 167,336 seedlings had been produced, comprising F_1 to F_4. Further crosses of the Ef strains were also made.

In the F_2 to F_4 generations of the backcrosses the proportion of resistants was well below 50 per cent and varied considerably with the particular variety of cultivated potato used.

The fourth backcross generation (F_4) contained numerous types in which nearly all the undesirable features of the Ef strains were absent or almost so ; and in 1932 numerous lines, which had so far retained their resistance were hardly inferior to the standard commercial varieties. In 1932 however there was a sudden outbreak of the fungus, which attacked all the hitherto resistant varieties and lines, although still not with equal ease or severity.

The author inclines to the view that a new biotype is the cause of this phenomenon and points out that little is known of the phases through which the fungus passes in overwintering and the possibility of particular conditions favouring the production of a new biotype during these phases ; a number of Ef descendants sent in 1932 to a station at a distance of 15 km. and others growing at a station 100 km. away were also attacked in exactly the same way and at the same time. All these facts are regarded as pointing to the action of external conditions as having caused the origin of the new biotype and as indicating that it originated in 1932 or the preceding winter. The necessity for further studies on the question of physiological forms in phytophthora is emphasized.

All the lines which the new biotype attacked in the leaves also proved susceptible in the tubers. *Solanum demissum* and its F_1 hybrids with cultivated potatoes proved 100 per cent resistant to the new as well as the old phytophthora cultures in the leaves, though susceptibility was observed on some of the tubers. The hybrids, though self-sterile, backcrossed easily with cultivated varieties. A quarter of the F_1 plants were also entirely undamaged by —3°C.

In later generations the resistance to the new biotype was very much reduced ; in the influence of different cultivated varieties on resistance and in most other respects the position was similar to that for the Ef hybrids and no very optimistic view is taken of the possibility of producing resistant types from this cross, except by carrying out the work on a very extensive scale indeed.

189. BUKASOV, S. M. 633.491.00.15(47)
(The results of 11 years' work with the potato, carried on at the Institute of Plant Industry.)
Bull. Appl. Bot. Leningrad 1932 : Ser. A (4) : 67–70.

A collection of all the potatoes in existence in the world has been built up, the material has been classified and described.

This study revealed the extreme narrowness of the material in cultivation, the same limited number of varieties being used repeatedly in different combinations. An expedition to South and Central America was sent to study the home of the potato, in regions hitherto untouched,

* An abridged translation of this paper is on file at the Bureau.

and disclosed the existence of an extreme diversity of cultivated species, mostly unknown, and some very close to the European cultivated species but possessed of qualities long sought for in vain in this species.
The wild species are even more varied. Amongst them are species resistant to both frost and phytophthora.
The existence of a polyploid series in the potato was disclosed, revealing for the first time cultivated species with 24, 36 and 60 chromosomes. The cytological study has for the first time rationalized the work of hybridization.
The species differ in their photoperiodic response, many will form tubers only under short day.
Methods of mass hybridization have been worked out and over 10,000 inflorescences have been crossed. Many of the hybrids already shew great promise, exceed the standards in yield, and are resistant to phytophthora.

FIBRES 633.5

190. GORJANSKII, M. M., MOSKVIN, I. A. and KANDALOV, M. I. 633.51(47)
(Cotton cultivation in North Kirgiz.)
Bull. N.I.H.I. Moscow and Tashkent. 1933 : Pp. 36.
Comparisons were made of some of the new numbers, sown direct and transplanted and with Navrotskii as control, in earliness, yield, etc.
Some of the new numbers exceeded Navrotskii in earliness.
The transplanted individuals preceded the seeded ones by 6 to 13 days in flowering and 8 to 22 in maturity, the greatest acceleration being in the late sorts ; a yield increase was observed only in the latest variety.
Navrotskii was the best in yield and length of lint, closely followed by No. 1306.

191. 633.51:575
AVTONOMOV, A. I. 633.51 Sea Island:575(47)
(For high yield and quality of Egyptian cotton).
Sredaznihi, Moscow and Tashkent 1933 : Pp. 83.
A general description of Sea Island cotton and its various forms is given, the annual *Gossypium barbadense* being of most interest for the Soviet Union, and various varieties, of the Ashmouni and Pima type, being compared with the typical Uplands.
The various attempts to improve the native Central Asiatic cottons by introduction and selection are outlined, including the selection by Navrotskii of the different varieties of this name and the final successful introduction of Sea Island cottons.
The various factors which result in variation and deterioration are discussed, and a brief outline is given of the principles of inheritance, pure line selection and cross-breeding.
In breeding Egyptian cottons the main problems are to increase the earliness, so as to enhance the yield in southern districts and extend the cultivation northward ; to reduce boll shedding ; to raise the lint quality of the highest yielding and earliest varieties, which are all deficient in this respect ; to raise also the lint yield in those varieties with the best quality and most uniform lint ; to raise the size of boll ; to reduce the rather high demands of the best varieties in respect of cultural conditions ; to produce varieties resistant to gummosis, to frost and cold, and suitable for mechanical cultivation in and between the rows and for mechanical harvesting. The ultimate desire is to combine all the qualities in one variety. The methods of achieving these various aims by breeding are briefly outlined. Promising results have been obtained by crossing the Egyptian cottons with the large-bolled perennial Peruvian cottons, with the aid of a reduction of the length of day to 9 hours for the Peruvians and hybrids. The perennial cottons introduce large size of bolls, abundant fruit bearing, length of lint, frost resistance ; their deficiency in earliness and ginning percentage is made up for by the annual Egyptian forms with which they are crossed, these being also characterized by high quality of lint. Amongst the varieties already produced are a Pima 4—7 days earlier than the normal type and with ginning percentage 3—4 per cent higher, one with equally good lint and a yield 30—50 per cent higher ; and line 4066 from Ashmouni with lint length equal to Maarad (48 mm.), yielding 20—30 per cent more than Ashmouni, which it equals in earliness.

192. KILLOUGH, D. T. and HORLACHER, W. R. 633.51:575.11.061.6
The inheritance of virescent yellow and red plant colours in cotton
Genetics 1933 : 18 : 329–34.

The paper describes the results to the F_3 of a cross between a virescent yellow and a plant having a red leaf. The virescent yellow form was derived from two plants, probably recent mutations, in a crop of Mebane cotton. The partial deficiency of chlorophyll to which the appearance is due, is most marked in the young plant. In the F_2 of the cross six types appear, dark and light red, dark and light bronze, green and virescent yellow ; and the observations are consistent with the explanation that virescent yellow is due to the absence of a factor (V), dark bronze having the constitution RRvv and light bronze, Rrvv. The genes R and V are inherited independently.

193. *KANASH, S. S. 633.51:575.127.2:576.356
(Interspecific hybridization within the limits of the cotton plant varieties with different chromosomes.)
Proc. Central Asia Sci. Res. Cotton Inst. (Sredaznikhi). The work of the Central Plant Breeding Station. Tashkent 1932 : Pp. 56.

Previous work on interspecific and intergeneric hybridization in cotton and other species is discussed. Experiments are then described in which *G. barbadense* was crossed with various 26 chromosome species in 1927. When any quantity, however small, of self pollen was present only maternal plants appeared in the progeny. When only foreign pollen was used, only one boll, containing two seeds, was obtained from 337 pollinated flowers, this being from the cross *G. barbadense* x *G. arboreum.*

The F_1 hybrid was intermediate in most morphological characters, with a tendency for the characters of *G. barbadense* to predominate. Marked heterosis occurred. The proportion of normally developed pollen grains was extremely low.

The F_1 plants were selfed and crossed with the parental and other species, all of which resulted in failure with the exception of the back-cross with *G. barbadense* ; on one plant four bolls were obtained, only one of which developed normally, whilst the others developed only one boll. Only one seed developed per boll and all were abnormal and failed to mature completely. Only one seed germinated and failed to produce a mature plant.

In the following year nine bolls were obtained from back-crosses with *G. barbadense,* four of which matured ; one boll was obtained from free pollination but failed to mature. The F_1 plants in both years displayed greater fertility in the later part of the year (late August and September) when the temperature was lower. The four seeds obtained gave rise in 1930 to two F_2 plants, which constitutes a new achievement in the field of cotton breeding and in consequence of which interspecific crossing was begun on a very much larger scale, involving all the main species in Zaitzev's classification and 10,496 crosses in all. Hybrids were obtained between all the species in all combinations and in both direct and reciprocal crosses, which were identical. Many of these represent combinations which have hitherto failed entirely. There is no indication that the lower chromosome species make better maternal parents, rather the reverse.

Certain species shewed a more marked tendency to parthenocarpy than others, especially the 26 chromosome species, but this was not associated with a greater capacity for hybridization, which was in fact greater in the 52 chromosome species.

The characters of the 52 chromosome species *G. barbadense* and *G. hirsutum* in all crosses shewed a tendency to predominate in the F_1's, anthocyanin pigment however being dominant no matter in which parent it occurred. Heterosis was observed in most but not all combinations.

So far no increase in self-fertility has been produced in the hybrids by any artificial agents but attempts are being made to induce polyploidy by reduced temperature, chloroform, etc.

Eight of the hybrids obtained proved fertile in backcrosses, the 52 chromosome parent being apparently more efficacious that the lower chromosome species. Three more hybrids proved partially fertile in their second year of life, a phenomenon also observed in other interspecific cotton hybrids, notably one observed by V. I. Kokuev produced by crossing F_1 *G. hirsutum* x *G. barbadense* by F_1 *G. Nanking* x *G. herbaceum.*

* A full translation of this paper is on file at the Bureau.

These successful crosses deny the independence of the four cotton groups claimed by Zaitzev.
The two F_2 plants obtained in the cross *G. barbadense* x *G. arboreum* are described. The first resembled *G. barbadense* in nearly all characters, some few being intermediate ; the second differed sharply from both parents, displaying certain characters belonging more to species of other groups, such as wide leaf lobes resembling *G. brasiliense* and *G. peruvianum*. The fruits are small, and pitted in a way not typical for any species of *Gossypium*.
The fertility of the first hybrid was considerable and it crossed with ease with *G. barbadense*, 27 fruits, containing 216 normal seeds being obtained in 1930 and 80 fruits in 1931 ; with other species it failed to cross, with the exception of one extremely interesting cross effected with *G. Nanking*. The other F_2 hybrid was completely self-sterile and had quite imperfect pollen. As female it produced a certain number of hybrids with *G. barbadense*.
The F_3, obtained partly from selfing and partly from backcrosses, was very heterogeneous, containing forms almost indistinguishable from the natural Sea Island, forms resembling the F_2 and certain forms resembling *G. arboreum*, and was extremely fertile ; a large and very varied F_4 is therefore anticipated.

194. NAKATOMI, S. 633.51:575.127.2:581.19
(Difference in peroxydase activity of the cotton species.)
Proc. Crop Sci. Soc. Japan 1932 : 4 : 295–303.
The intensity of peroxydase action is much greater in Old World cotton with 26 chromosomes than in New World cotton with 52. Different species with the same number of chromosomes do not differ greatly in their peroxydase activity. In crosses of two parents with different chromosome complements the peroxydase activity of the F_1 is either intermediate or the degree of intensity of one or other parent is dominant.

195. LAUMONT, P. and ISMAN, M. 633.51:575.42(65)
Observations sur la sélection du cotonnier d'Égypte en Algérie. **(Observations on the selection of Egyptian cotton in Algeria.)**
C. R. Ass. Franç. Av. Sci. 1930 : 54 : 639–44.
The work started with pedigree selection based on vigour, earliness, weight of seeds, lint index, lint length, ginning percentage and tenacity, fineness and extensibility of lint.
Some of the selections combine higher yield with finer, altogether better lint than the ordinary Algerian cottons, some of them measuring only 16 μ.
The lines are kept pure by bagging.
A description is given of the characters and performance of one of the best selections, No. 26, from Pima.

196. NAGIBIN, Ja. D. 633.51–1.531.12
(New high-bred varieties of cotton in the campaign to raise the productivity and quality of cotton.)
Za vysokii urožai khlopka (For high cottton yield), Tashkent 1933 : 115–23.
The importance of efficient seed production and control in connexion with the introduction of high-bred varieties is emphasized.

197. LEBEDEV, A. D. 633.52:575:677.11
Technical points in breeding flax for fibre.)
Bull. Appl. Bot. Leningrad 1933 : Ser. 2 (4) : 35–106.
The total length of the stem and its thickness are the only points of any technological significance. To these should be added absence of branching and uniformity. Among other characters, resistance to lodging and diseases, yield and quality of fibre, and ease of its extraction are of most importance.
The various factors influencing these characters are discussed at some length, together with such questions as the most favourable length and diameter of stem and the most favourable combination of these two, and the most favourable capsule number (regarded as 3).
Breeding for increased total yield of fibre results also in an enhanced strength and quality of the

dressed fibre, together with a greater relative yield of dressed fibre. The minimum yield of fibre is fixed for breeding purposes at 22% ; the anatomical method of evaluation, ignoring the structure of the secondary xylem, is regarded as unsatisfactory. An inverse proportion was observed between total yield of fibre and yield of straw, duration of setting and loss in retting, the two latter being a favourable correlation. Yield of fibre and stem should take first place in a breeding programme ; examples are given to illustrate the extremely low chances of obtaining combinations of increased fibre yield with various other characters, the probability being reduced with each increase in the number of other characters considered. In view of the not infrequent occurrence of cross-pollination the common flax varieties are mixed populations, probably containing odd individuals with more than average fibre content ; but the absence of any morphological characters directly correlated with fibre yield makes the detection of such individuals a matter of extreme difficulty. Satisfactory increases of the fibre yield are only to be obtained by the " synthetic " method, viz. by hybridization.

198. VEER, H. de 633.513:575.42
De selectie van kapok. (Kapok selection.)
Landbouw, Buitenzorg 1930/31 : **6.**

Prior to 1928, selection was based upon tests of phenotypically superior seedlings of scions (mainly on Suriname stocks) and upon observations of seedlings obtained for comparison from seed from the same selected mother trees or clones from which the test seedlings or scions had been taken.

In 1928, as a result of the reorganization of the Buitenzorg Experimental Station kapok selection was considerably developed and in 1929 selection and seed plots were to be laid out at Muktihardjo, and seed beds and nurseries at Bangsri .The 24 sowings at Bangsri in 1930 are shewn in a table with a description of their types, and from these individuals seed or grafts for future selection work were obtained. Seed and budwood for the Muktihardjo breeding and seed plots were to be obtained from a collection of varietal types established in 1926 in the Tjibinong seed plots where a series of seedlings and buddings from the same mother trees or clones were planted out. The Tjibinong material and its origin are fully described.

In the future work of kapok selection the performance of the progeny is all important. Vegetative propagation was shewn to be easily effected by means of budding. As regards the influence of the stock on the scion it was found that growth on Suriname-kapok is exceptionally vigorous as compared with others, but there were indications that Sirinname-kapok as a stock retards the time of bearing and possibly also affects the regularity of fruiting. Since sexual reproduction seemed likely to retain its position as a method of propagation the question of obtaining pure breeding stock would be of outstanding interest. A study of the biology of flowering seemed to shew that self-pollination played an important role in reproduction so that kapok should as a rule be markedly homozygous, a fact which would simplify breeding work once superior mother trees had been discovered.

Other investigations also seemed to shew that artificial crosses can be successfully made and this point as well as the questions of vegetative propagation, stocks, improved yields from grafts and the validity of the results at Muktihardjo for other localities should all be examined.

At Tjanroe in South Celebes it was intended to establish a kapok selection plot for use later as a seed nursery.

199. 633.52:575.127.2
FISCHBACH, C. 575.12:578.08
Untersuchungen an den beiden heterostylen Leinarten *Linum hirsutum* und *Linum viscosum* und ihren Bastarden (*L. hirsutum* ♀ x *L. viscosum* ♂ und *L. viscosum* ♀ x *L. hirsutum* ♂). (**Investigations on the heterostylous flax species *Linum hirsutum* and *Linum viscosum* and [their hybrids** (*L. hirsutum* ♀ x *L. viscosum* ♂ **and *L. viscosum* ♀ x *L. hirsutum* ♂.)**
Z. indukt. Abstamm.–u. VererbLehre. 1933 : **65** : 180–242.

The size of the hybrid seed was influenced by both maternal and paternal parents, being intermediate between the two but larger in the cross with the large-seeded female parent than in the reciprocal. Figures are given shewing that these differences are significant both for the length and breadth of the seed.

The size relations of the embryos were quite different, the hybrid *L. viscosum* x *L. hirsutum* having excessively small embryos and correspondingly abnormally light seeds.

In germination tests the seeds of *L. hirsutum* display the greatest percentage and rapidity of germination, with a germination percentage of 90·6 as against 80 per cent for *L. viscosum*, which began to germinate three days later. The hybrid *L. hirsutum* x *L. viscosum* was intermediate; of the reciprocal hybrid only two seedlings were obtained, and this only as a result of removal of the embryos and very careful treatment of a large number of seeds. At temperatures below 8°C. *L. viscosum* almost failed to germinate, whilst the hybrid *L. hirsutum* x *L. viscosum*, although the germination percentage was not affected, exhibited a reduced vitality of the seedlings, many of which died. *L. hirsutum* was not affected by reduced temperature.

After pollinating two stigmas of the flower *L. viscosum* with pollen of *L. hirsutum*, two other stigmas were pollinated with self pollen ½–2 hours later, the fifth stigma being left unpollinated. In this way 32 hybrid seeds were obtained, of which 12 (37·7 per cent) germinated with ease, and one without artificial aid ; 7 seedling plants were successfully obtained. In a similar experiment carried out in an earlier year a survival of 33·3 per cent was obtained, 3 of the plants germinating without artificial aid. In the reciprocal experiment hybrid seeds were obtained even when foreign and self pollen were applied simultaneously and the results from this experiment were more favourable even than self-pollinations of *L. hirsutum*. It is thought that this method may be worthy of more general application.

The hybrid plants developed more vigorously than the female parent. In morphological characters marked differences were detectable between the two hybrids ; many characters such as stem length although intermediate in the hybrids tended to be influenced much more by the female than the male parent ; differences of this nature were also evident in such characters as size and form of leaf. Both hybrids produced variegated shoots, although the parents were free from chlorophyll defects, and the colour of the shoots produced by the reciprocal hybrids differed : the variegation occurred only in the early part of the year and only in plants grown in the open air ; variegation apparently resulted from the action of the low temperature, being capable of reversal by the action of higher temperatures.

The intermediate character of the hybrids, with a strong tendency to matrocliny, was evident again in the size and form of the various floral organs, as well as in their colour and various other characters, including the unequal height of the anthers characteristic of *L. hirsutum* and also the length of the pedicel of the fruit.

The number of seeds per capsule was lower in *L. viscosum* than in *L. hirsutum* but under conditions of artificial self-pollination no lower in long than in short-styled plants.

The hybrids contained no more than 0·5 per cent good pollen grains, these being however larger than in the parents.

Backcrosses with *L. hirsutum* gave fruits, which were however devoid of seeds in the early part of the year ; on repeating the crosses later eight seeds were obtained from the backcross of *L. hirsutum* x *L. viscosum* and six from the backcross of the reciprocal. The backcrosses to *L. viscosum* on the other hand were more successful in the early part of the year.

The *L. hirsutum* x *L. viscosum* hybrid produced no seed in any of the crosses made with it, although the reciprocal hybrid gave a few seeds when pollinated with *L. hirsutum*.

Pollen formation was regular in *L. hirsutum* and nearly so in *L. viscosum* ; the size of pollen in *L. hirsutum* was seen to rise with the length of the anthers. The chromosome number in both species was 8. In the hybrids great irregularities were observed leading mostly to abnormal pollen grain, though the stages of meiosis were regular until diakinesis, where pairing frequently failed. Chromosome separation was often irregular and the second division often set in before the end of the first. Multipolar spindles also occurred. In some anthers complete degeneration of the pollen grains also ensued and such anthers never yielded functional pollen.

These results, especially the number of characters in which the parents differ, shew that they constitute two well-defined species.

200. 633.52:575.42:578.08
LEBEDEV, A. D. 633.52:677.11:578.081
(On the methodics of sorting flax varieties.)
Bull. Appl. Bot. Leningrad 1933 : Ser. 2 (4) : 107–33.

Trials of sixty-four varieties in 1928-1930 shewed that the total fibre yield was subject to considerable variation ; those varieties which were above the average in both 1928 and 1929 proved to be superior also in a number of other characters, such as total and relative yield of dressed fibre and its quality and the relative value of a weight unit of stem. Of these superior varieties there were 20, another 24 were consistently inferior and the remaining 20 variable. A still more rigid division into good and bad varieties could be effected by separating only those above and those below a certain limit, leaving the rest as " intermediate." Again the same correlation between the fibre characters was evident and a greater consistency of good (or bad) yield resulted. The 1930 results shewed where these limits should be set, in order to ensure that the varieties in the two groups should be respectively 15·3% above and below the mean also in the following year. The ten best varieties were selected in this way. On sorting according to the relative value of a weight unit of stem the ten best varieties were also separated, seven of these were the same as those selected by the previous method. A satisfactory selection of the four best varieties was made on similar lines with respect also to yield of fibre from pulp. Similar tests on straw yield disclosed an inverse proportion between this and total yield of fibre. The yield of fibre from a unit area is a less suitable standard of selection than total fibre yield, since a large quantity of straw with a low fibre content will give a high yield of fibre per unit area but is technically undesirable. Quality and loss in retting were so variable as to be almost useless for selection, hardly any varieties having the same grade in successive years. The loss in retting shewed a slight tendency to fall with a rise in fibre yield.

The variations from year to year and from place to place are considerable. In beginning breeding the author advises the establishment of a collection of standard varieties consisting of those most suited to the latitude in question. By constantly removing the least successful the standard collection will come to represent those varieties adapted to the district. The second step is to select the most consistently good as described above. Any new varieties or lines are included in the system and compared with the standard collection.

201. KAPPERT, H. 633.52:581.331:575.11
Erbliche Polyembryonie bei *Linum usitatissimum*. **(Inherited polyembrony in *Linum usitatissimum*).**
Biol. Zbl. 1933 : **53** : 276–307.

An elaborate study of polyembrony in flax based on observations on over three-quarter million flax seeds. In 1928 the discovery of five cases of twinning in 28,000 F_2 flax seeds led to an investigation of the origin of twins and the frequency of polyembrony in different flax strains derived from the same cross.

By an ingenious analysis of the genetic behaviour of the colour types in a cross of white x blue plants it is deduced that *Linum usitatissimum* exhibits true polyembrony, i.e. the origin of multiple embryos from one embryo sac. It would also seem that the majority of cases of polyembrony in flax are due to the fertilization of several nuclei of one embryo sac by the nuclei of one pollen tube ; and the most likely mode of origin of normal twins from one embryo sac is by cleavage of the young zygote. The possibility of haploid and diplo-haploid twinning is also discussed. Cytological proof of the origin of normal multiple embryos was also obtained from a study of the actual developmental stages of the embryo sac and the confirmatory evidence was obtained from the close similarity in the genetic behaviour of three pairs of twins from one parent plant, the members of each pair resembling each other but differing from the other pairs.

As regards the mode of inheritance of polyembrony it is suggested that both in the case of diploid and haploid origin the newly formed zygotes—and not the maternal plants—are the bearers of the character. Moreover it must be noted that while the tendency to polyembrony may be constitutional, chance, i.e. environment and not the genotype, determines which of the zygotes formed shall become twins. The tendency of the mother plant is manifested only in a small percentage of the seed.

From a detailed analysis of the author's own crosses it is concluded that polyembrony is a recessive character probably conditioned by a series of multiple factors.
In discussing the relation between polyembrony and the hybrid nature of the polyembrionic mother plants it is pointed out that " habitual " polyembrony resulting from a cross has now been demonstrated for the first time. In flax, however, no complex causal relationship is suggested and hybridization apparently merely results in the suitable recombination of the recessive multiple factors from various strains as a consequence of which polyembrony segregates out in certain lines.

202. SERDYUKOV, V. K. 633.52:677.11:578.081
(The method " Skootch " in comparison to the organoleptic estimation of the flax fibre.)
Bull. Appl. Bot. Leningrad 1933 : 215–32.
The various characters of the fibre which influence its quality are enumerated and discussed and the defects of present methods of judgment indicated. The new method of V.C. Klubov consists in the calculation of a quality coefficient based on individual determinations of the sliding, strength, toughness and purity of the fibre, the initials of which Russian words give the method its name. The main characters of the fibre are colour, length, fineness, purity, oiliness, weight, strength, elasticity, toughness, and hygroscopic power, but the determination of the above four of these is regarded as adequate as an indication of quality, some of the ten factors being interdependent, others incapable of determination.
The experiments here reported were designed to test the reliability of the method, compared with the full " organoleptic " method. The average result of ten determinations of a rather uniform fibre agreed well, but considerable deviations were observed between the individual determinations. These deviations were attributable to errors in determination of strength, which, it has been shewn, cannot be determined accurately on as few as ten samples, three and occasionally up to five lots of ten being necessary for a reliable determination. Deviations were also observed in determinations of strength, for which it is also desirable that a number of determinations be made.
Even taking all these points into consideration the " Skootch " method still gives deviations of very considerable magnitude, tending to rate low-quality fibres too high and high-quality too low, largely in consequence of the failure of the four factors to take into account all the constituents of fibre quality. Colour and injury by disease are two very important factors which the method ignores.
Coefficients of correlation between the individual four factors and quality determined by the " organoleptic " method were low (varying from +0·09 to 0·55) ; between the quality determined by the " Skootch " and by the " organoleptic " method + 0·5 + 0·05. On these various grounds therefore the method is regarded as an unsatisfactory substitute for the " organoleptic " method.

203. PARIEVSKAIA, A. P. 633.522–2.5–1.521.6
(On the resistance of Russian and foreign sorts of hemp to *Orobanche ramosa*.)
Bull. Plant Protection Leningrad 1932 : **5** : 73–84.
Amongst a number of strains of hemp tested for reaction to the parasite, the Italian ones proved quite immune and the French ones were very little damaged. The importance of this from a breeding point of view is indicated.

204. HÅKANSSON, A. 633.584.3:575.127.2:576.354.4
Die Konjugation der Chromosomen bei einigen *Salix*-Bastarden. **(The conjugation of the chromosomes in a number of *Salix* hybrids.)**
Hereditas 1933 : **18** : 199–214.
Mention is made of the ease with which *Salix* species hybridize ; even when two species do not cross directly their hybrids with other species can often be combined. Owing to this frequent hybridization the taxonomy of the species is extremely confused. The so-called species *S. nigricans* and *S. viminalis* are only the two extreme variants of a more or less unbroken series of

forms uniting them and are in all probability not distinct species. Their hybrid is entirely fertile and in the present investigation proved to have 57 chromosomes, a number also previously reported for *S. nigricans*. Although the haploid number 44 has been reported for *S. phylicifolia*, the present observations of anaphase I shewed 57 also for this species. Certain uni- and polyvalent elements were present in addition to the ordinary bivalents, with evidence of lagging chromosomes during anaphase. Multiple association of chromosomes occurred at second metaphase.
The formation of polyvalents was also frequent in the hybrid *S. nigricans* x *S. phylicifolia*, though from the material it was not clear just how frequent or whether association of more than 6 chromosomes occurred. It was somewhat more frequent however than in *S. phylicifolia*. The chromosome behaviour and the second division were comparatively regular, except that the same association of the chromosomes occurred and occasionally the 2 dyad nuclei fused, giving a nucleus with unreduced chromosome number, a phenomenon not observed in *S. phylicifolia* itself.
This hybrid was crossed with a *S. viminalis* x *S. caprea* hybrid, which itself had thoroughly regular reduction division and was fertile, having 19 haploid chromosomes. The pairing in the complex hybrid was good, mostly bivalents, but polyvalents were observed not infrequently ; univalents were conspicuously rare. The second division was very regular.
This behaviour indicates an almost complete autosyndetic pairing of the 38 *phylicifolia* and *nigricans* chromosomes, in its turn pointing to a high degree of polyploidy in these species.
The occurrence of univalents in the hybrids is not a sign of incompatibility of the chromosomes but a natural consequence of the formation of polyvalents resulting from polyploidy.

205. YAMAURA, A. 633.584.5:576.312.35
[Karyological and embryological studies on some bamboo species. (Preliminary contribution).]
Bot. Mag. Tokyo 1933 : **47** : 551–55.
Of the 7 Japanese species and varieties examined, *Sasa kozasa* Nakai, *Sasa kurilensis* var. *cernua* Nakai, *Sasa kurilensis* var. *Uchidai* Makino, *Sasa paniculata* var. *paniculata* Nakai, *Sasamorpha borealis* Nakai, *Pleioblastus Maximowiczii* Nakai and *Bambusa nana* Roxb., six were tetraploid (2n = 48) and one (*Bambusa nana*) proved hexaploid (2n = 72). Abnormalities such as 96 chromosomes in the root tips and diploid nuclei in the pollen mother cells were occasionally found in *Sasamorpha borealis* and *Pleioblastus Maximowiczii* respectively.
Abnormal numbers of antipodal cells were observed in *Sasa*, *Sasamorpha* and *Pleioblastus*, 300 being present in an extreme case.
It is suggested that 5, 7 and 12 should be regarded as the basic number in the family of the Gramineae.

SUGAR PLANTS 633.6

206. L. . . . . , C. G. 633.61:575(96.9)
Notes on seedlings-Kauai.
Hawaii. Plant. Rec. 1933 : **37** : p. 6.
Cane 28–3540, from Yellow Caledonia x H109, is shewing great promise. It is completely resistant to eye spot. Also 28–2055, from a cross of a Java cane by 26C 270 ; this cane shews commercial resistance to eye spot and another cane, 30–2417, from 28–274 (POJ2364 x 26C270) x H456, is immune to eye spot and brown stripe and otherwise also highly promising.

207. W(ELLER), D. M. and M(ANGELSDORF), A. J. 633.61:576.312.32
Chromosomes of sugar cane.
Hawaii. Plant. Rec. 1933 : **37** : 26–31.
A brief popular account of chromosome behaviour in general and of Bremer's work on the meiosis in crosses of wild and noble canes, where doubling of the egg cell chromosomes leads to the production of polyploid forms shewing more resemblance to the noble, female parent than to the *spontaneum* male.

208. CROSS, W. E. 633.61–2.111–1.521.6
El problema de la caña helada. **(The problem of frosted cane.)**
Bol. Estac. Exptl. Agric. Tucumán. 1933 : No. 22 : Pp. 31.
The general causes, symptoms, treatment and prevention of damage from cold are discussed. The relative injury suffered by different cane varieties was observed in various unfavourable years with a series of frosts followed by warm weather (e.g. in 1918, where temperatures fell to —6·8°C.). Certain canes, notably P.O.J. 36 and P.O.J. 213, suffered much less than the others and remained in good condition until quite late in the season.

209. MALPEAUX, L. 633.63:575.42
La sélection de la betterave à sucre. **(Selection of sugar beet).**
Vie Agric. Rur. 1932 : **21** : 245–50.
The advantages of individual plant selection as opposed to mass selection are enlarged upon, with indications of the various characters for which it is desirable to select, such as good form, long beets, easy to pull, abundant and upright foliage, good weight, high sugar content and purity, and of the methods of carrying out selection, including isolation.
In his remarks the author points out the dangers of cross-pollination inherent in the method of spatial isolation, since pollen is carried over 2 kilometres by the wind. Self-pollination is ensured by isolating in fine cloth, the plants being repeatedly shaken to transfer pollen from one flower to another.
After élite lines have been created by repeated self-pollination two individuals of good lines are isolated together to obtain crossed seed, thus restoring the vigour.
Observations are made on the inheritance of weight and sugar content, graphs of these 2 being made for each élite. From the best of these superélites are selected. Multiplication is effected by " reliable farmers." The precautions undertaken are enumerated.
As a result of these measures a rise in sugar content has been observable since 1920 but there is a danger that this may be accompanied by a reduction in total yield, so that a compromise in these two respects is recommended. The necessity for efficient seed production for maintaining the qualities of the seed is also emphasized.

210. CARSNER, E. 633.63–2.8–1.521.6:575
Curly-top resistance in sugar beets and tests of the resistant variety U.S. No. 1.
Tech. Bull. U.S. Dept. Agric. 1933 : No. 360 : Pp. 68.
The strain U.S. No. 1 represents a collection of resistant types with a satisfactory sugar content. Complete immunity is not claimed but the varying degrees of resistance provide material for further selection.

STIMULANTS 633.7

211. GOODSPEED, T. H. 633.71:576.312.35
Chromosome number and morphology in *Nicotiana* VI. Chromosome numbers of forty species.
Proc. Nat. Acad. Sci. Wash. 1933 : **19** : 649–53.
A morphological, distributional and cytogenetic study of races of *Nicotiana* has resulted in the identification of 40 species for which the chromosome numbers are given. Among the 32II races an instance of polyploidy within the species was found.
Some 50 interspecific hybrids of *Nicotiana* were obtained, including 3 amphidiploid types, *digluta* (n=36) from *glutinosa* x *tabacum*, *diglutosa* (n=24) from *glutinosa* x *tomentosa* and *disualovii* (n = 40) from *suaveolens* x *Bigelovii*.
Numerous aneuploids in various species, and tetraploids and haplonts have been studied. The haplonts known at present are in the 9II, 12II and 24II groups, i.e. *glutinosa*, *tabacum*, *nudicaulis* and *Langsdorffii*.

A number of different quantitative chromosome alterations have been established by irradiation in stable derivatives of *tabacum* and *sylvestris*. A number of sesquidiploid forms have also been obtained.
Investigation of the chromosome numbers of certain related genera has drawn attention to the fact that in *Petunia*, which has been reported to hybridize with Nicotiana, a 9II species has recently been found.
From the standpoint of species origins and relationships in *Nicotiana* the following provisional conclusions from the work in progress are of interest :—(1) Certain genetic groups characterized by similarity in chromosome number and in certain basic morphological factors have been recognized. (2) Some, if not all, of the 24II species are of allopolyploid origin, thus for example *tabacum* (n = 24) may be traced to derivatives of hybrids between the " *tomentosa* group " (n = 12) and *sylvestris* (n = 12).

212. LAMMERTS, W. E. 633.71:576.356.5
An experimentally produced secondary polyploid in the genus *Nicotiana*.
Cytologia 1932 : 4 : 38–45.
The plants described arose from the selfed progeny of a backcross between F_1 diploid female gametes of the cross *N. rustica* x *N. paniculata* and *N. rustica*. The original plant shewed a total of 62 chromosomes. Selfing was continued into the F_8 from the original cross, the chromosome numbers of the progeny varying between 60—56 representing two sets of *rustica* and one of *paniculata*. Chromosome pairing was also variable. Morphologically the plants were sufficiently distinct from either parent to be regarded as a new species. The relative lowness of the fertility was apparently due to zygotic elimination and not to bad pollen or ovule reduction. It is suggested that plants with higher chromosome numbers not in the polyploid series may arise in a similar manner and the difficulties presented by such an origin of new species are discussed.

213. LAMMERTS, W. E. 633.71:576.356.5:575.129
The *Nicotiana rustica-paniculata* amphidiploid derivatives.
Cytologia 1932 : 4 : 46–51.
A study was made of the selfed lines from the most striking varieties of the F_3 of the amphidiploid *N. rustica-paniculata* hybrid. A variable number of quadrivalents was found at the first metaphase. The lines were all uniform by the F_7. The majority of the plants had 72 chromosomes and their behaviour indicates that " dissociation of quadrivalents in the original F_2 plants was not strictly preferential and that complete substitution is possible in some quadrivalents at least." Three light green variants in one of the lines proved to be haploids ; one which shewed a quadrivalent was backcrossed to *N. rustica* and as each of the two surviving plants shewed a bivalent it is assumed that the original quadrivalent is a true quadrivalent and not the result of reciprocal translocation.

214. WELLENSIEK, S. J. 633.72:575.42
De aanleg van geselecteerde theezaadtuinen. (**Planting gardens for selected tea seed.**)
Bergcultures 1933 : 7 : 712–17.
The prevalent method of planting gardens for selected tea seed, as introduced by Cohen Stuart in 1929, is outlined.
This practice may be modified since it has been established experimentally : (1) that in the nursery selection by eye is accurate enough to supplant weighing ; also a well-formed tap root is the basis for further selection, (2) selective thinning from the plucking garden left such an irregular stand in the garden that transplanting became general. Therefore the selected seed trees are transplanted from the plucking garden into a new seed garden and the remaining trees are left practically intact. Transplanting 4—5 year old plants has not proved a disadvantage if done at a good season, (3) in the plucking garden the 50—60 poorest yielders per cent can be spotted accurately by eye, so that a preliminary selection by eye simplifies individual yield determination. Capacity for yield is a composite factor ; the 5 chief components are : the size of plucking surface,

thickness of shoot and size of leaf, all of which will be observed in selection by eye ; so also will rapidity of shooting if selection is done shortly after plucking. Observations shew that plants that shoot rapidly yield about 30 per cent more than those that shoot slowly. The fifth component, periodicity of shooting and resting stages, involves more protracted attention.

Results from experiments.

Selection of the best 20 per cent in the nursery, as specified, leads to an improvement in yield of between 10 and 30 per cent. Results of selection in the plucking garden depend largely upon the original material ; from the material so far studied an increase in yield up to 100 per cent may be obtained.

Future developments.

It should be possible by close planting to make preliminary selection in the nursery at 6—8 weeks old.

More knowledge of suitable types is required.

Further analysis of capacity for yield should lead to simplification of selection in the plucking garden.

Now that a satisfactory method of budding is practicable, homogeneous material should become available for study, and other advantages should accrue,

Selection in the nursery should bring with it, in addition to increased yield, more homogeneity of development and better spread, but it is more expensive. It should also lead to better stocks for budding purposes, for the chief influence of stock on scion appears to be that of vigour of growth.

215. FERWERDA, F. P. 633.73:581.162.3

Methoden ter verkrijging van productieve enten-aanplantingen bij koffie. **(Methods of obtaining productive grafted plantations with coffee.)** Bergcultures 1933 : **7** : 633–41.

Investigations have been carried out at Bangelan since 1930 on the fruiting effects of one clone upon another.

By dividing into strips from outside inwards large fields containing single self-sterile clones, it is shewn that the number of fruits set decreases towards the inside where the chances of cross-pollination are least. Allowances have been made for the increased light and space. Self-fertile clones shew the reverse effect.

To ensure satisfactory fruit setting the possible courses are : (1) to use self-fertile clones ; (2) to mix grafts and seedlings ; (3) to mix clones ; (4) to graft the poor seedlings in seedling field with budwood from good clones.

Mixing clones or buddings and seedlings involves (1) simultaneous flowering which is less important when seedlings are present ; (2) suitable mutual position.

The flowering time of clones should be determined by trial and observation ; it may be different for different localities. Experiments have been carried out to test mutual compatibility of a few clones with very variable results (percentages only are given).

With most clones of *Robusta* and similar kinds selfing leads to poorer fruit setting than crossing does. Clones differ in their paternal amd maternal values. It seems that some clones are universal female and others universal male parents.

In some hybrids, e.g. Kawisari, Sr. Sengkareng, selfing and crossing give much the same results ; Q.P. is definitely self-incompatible. Of the four *Congensis* clones investigated, two were self-incompatible and two equally good selfed or crossed. Hence, almost without exception, selfing leads to poorer fruit setting than crossing does.

Therefore monoclone planting would almost always produce unfavourable results and it seems best to mix a fair number (5 to 10) of good clones or to mix clones and seedlings by grafting the poorer specimens on existing fields of seedlings in preference to planting seedlings and grafts together.

The method of mixing is discussed. Various mixtures are being tried with promising results. When mixing for fruit setting relative habit and speed of growth are important considerations ; also size of bean, time of ripening, etc.

A warning against the use of untried clones is given ; the proportion of servicable clones is very low.

216. 633.74.00.14(81)
Relatorio e annuario do Instituto de Cacáo da Bahia. **(Report and annual of the Instituto de Cacáo da Bahia.) 1932.**
A full account of the organization of the new Cacao Institute and of the plantations already planted up. Of cacao, in addition to pure white-seeded Criollo, whose cultivation is extending, only varieties of Para, with occasional plants of Maranhao and hybrids of Comum, are planted; all the three latter varieties belong to *Theobroma leiocarpum* Bern. The Maranhao occurs always in plantations of Para, from which it is thought to be derived. Various sub-varieties of Para are mentioned and reference is made to a " male cacao," giving abundant flowers but no fruit, which is thought to be a mutant.
Details of cultivation and production of cacao in Bahia are given.

217. BLARINGHEM, L. 633.75:575.114.3:575.242
Sur un cas d'atavisme apparu dans une lignée de Pavot à opium. **(A case of atavism appearing in a line of opium poppy.)**
C.R. Acad. Sci. Paris 1932 : **195** : 1192–95.
Amongst the five million plants of a white flowered line grown during seven generations one plant appeared with red margins, a character possessed also by an ancient Japanese race. The plant is ascribed to a dominant mutation and simple segregation occurred in F_2.
The methods used in pollinating and measures taken to prevent cross-pollination are described.

OIL PLANTS, ETC. 633·8.

218. *SAAKOV, S. G. 633.8.00.15(47)
(The development of the cultivation of essential oil plants in U.S.S.R.)
Bull. Appl. Bot. Leningrad 1932 : Ser. A (4) : 77–84.
The cultivation of the old plants has been much extended and innumerable new forms and species have been introduced as a result of expeditions to collect the world material, which is now being subjected to botanical investigation. The material is classified, pure lines are made and breeding work has already given promising results in lavender, coriander, mint, etc.

219. HILTEBRANDT, V. M. 633.853.74:581.9
(Geographical distribution of the economical characters of sesame, and the utilization of its world assortment under the conditions of U.S.S.R.)
Bull. Appl. Bot. Leningrad 1933 : Ser. A (5–6) : 106–24.
The geographical distribution of the sesames according to time of maturity is indicated. Central Asia contains all the types of any possible interest for cultivation in the U.S.S.R., including two centres of extremly early forms in Turkmenia. Valuable forms of medium earliness are found in Asia Minor and in Central Asia, of normal time of maturity in Asia Minor and medium–late in Transcaucasia and the Tajik Republic.
The forms of certain countries are characterized by susceptibility to disease, those of others by immunity. The highest proportion of immunity to *Fusarium* occurs in Asia Minor, diminishing in all directions and reaching a minimum in the regions near the primary centre of origin (Africa, India, Japan and America); certain discrepancies in the results from Transcaucasia and Central Asia are probably due to differences in the physiological forms present. The gumming observed in the collection in forms from certain regions is considered to be a reaction to changed ecological conditions. The greatest susceptibility to bacterial disease occurs in the forms from Khiva. An inverse relationship holds between attack by bacterial disease and gumming. The existence of physiological forms of the bacterium is suggested. Immunity was observed only in forms from Manchuria and the Far East.

*** An abridged translation of this paper is on file at the Bureau.**

Samples vary in oil content from 49 to 62 per cent, the highest being the white-seeded and the lowest the black ; Palestine, Syria, Asia Minor and Rhodes have the forms with the highest oil content, there being a gradual diminution towards the East. The oil content shews considerable variation also within the populations, a line with 62 per cent having been isolated from material from Central Asia. A similar diminution towards the East is observed in size and weight of seed. The number of branches varies from 0 to 20 ; in the Soviet Union, Transcaucasia has the greatest degree of branching, Central Asia contains all types and Uzbekistan the lowest degree ; northern forms tend to have a small number of branches. A tendency of the branches to droop is observed in the forms from Palestine and neighbouring countries, forms with imperfectly developed false septum are characteristic and endemic for Central Asia, in some districts of which no others occur ; both these are undesirable characters. Non-shattering is a valuable characteristic of the quadri-carpellate forms of China and Japan.
Forms combining a large number of branches with three flowers per axil are rare but should be produced by hybridization. Within the Soviet Union forms with three flowers are most frequent in Central Asia. Light coloured seeds occur only in central Asia Minor, Rhodes, Manchuria, Japan and West China.
In addition to yield and quality, breeding is mainly directed to increasing the degree of earliness. A table is given indicating which regions offer suitable material for (1) selection and (2) hybridization, with respect to the various characters concerned. For all districts where sesame is already grown crossing with the local forms is recommended.

RUBBER PLANTS 633.9

220. FREY-WYSSLING, A. 633.912
Kenmerken van taprijpe oculaties der AVROS–cloonen. (**Characteristics of tappable buddings of the AVROS-clones.**)
Arch. Rubberc. Ned.–Ind. 1933 : 17 : 1–12.
In identifying tappable buddings the bark properties constitute the most important clonal characteristics and they are very constant within a clone. With few exceptions the Avros clones described can be distinguished by their bark. It is an interesting fact that the bark characters are frequently inherited in a marked degree by the filial generation from a clone. The inheritance of bark characters makes it difficult to distinguish new clones selected from seedling descendants of a mother clone, but in young trees the type of branching is a useful clonal characteristic for purposes of identification, though much finer distinctions can be taken into account in judging four-year-old trees by their bark. Three characteristic types of branching are described.

221. HEUSSER, C. 633.912–1.534
Productiecijfers van *Hevea* marcotten in vergelijking met de overeenkomende zaailing-individuen. (**Yield figures of *Hevea* marcots as compared with the corresponding seedling trees.**)
Arch. Rubberc. Ned.–Ind. 1933 : 17 : 13–23.
Hevea seedlings to the number of 1498 were layered in the nurseries when 11 months old and one marcot was obtained from each seedling ; satisfactory root formation occurred in 94 per cent of cases.
On some estates there was a marked correlation in yield and girth between the marcots and the corresponding seedlings but no such correlation was evident on other estates. It is suggested that the experiment should be repeated after identification of the trees by means of the seed and also standardization of height and length of the tapping cuts and elimination of diseased trees, as it is important for selection purposes to determine effects of environment on yield.
Probably a successful marcot is not inferior to a budding since the yield of the marcots was about 75 per cent of the yield of the seedlings and in general their development was good.

222. NATIVIDADE, J. V. 634:581.162.5
A improdutividade em pomologia. Estudo fisiológico e citológico. (**Reduced productivity in pomology. A physiological and cytological study.**) Professorial Dissertation in Arboriculture and Horticulture, Ampelography and Viticulture, Instituto Superior de Agronomia, Lisbon 1932: Pp. 229.

As the purity of the orchards is increased the questions of productivity and fertility assume more and more importance, since none of the best pomoid and prunoid fruits are capable of being cultivated pure. The present work describes a study of 50 varieties of different Portuguese fruit trees.

Detailed studies were made of the development of the flower and fruit on two apple varieties, Bismarck and Casa Nova da Alcobaca, and of meiosis in 22 Portuguese varieties of applies, 16 of pears and also certain varieties of *Prunus*.

The development of the flower buds is described and illustrated in all its stages from the beginning of development up to fertilization. The first period of development coincides with that reported by other investigators, viz. June, July and early August, varying slightly according to region and variety.

The importance of karyological studies in relation to sterility is emphasized and there is a brief introductory section on karyology in general and in relation to the pomoid fruits in particular. The development of the anthers and microspores is described in some detail for the pear Carapinheira and the dates given at which nuclear division is most active in the varieties of *Prunus* and *Pyrus* investigated. Similar descriptions follow for the development of the embryo sac, very few of which in the apple varieties examined, especially the triploids, were normal.

Pollination and fertilization are described, followed by a discussion of the parthenocarpic development of the fruit. In over 2,000 pears examined, no correlation was evident between the asymmetry of the fruit and the position of the seeds, or between the number of seeds and the volume of fruits. The opinion is expressed however that fruits with fertile seeds tend to have the advantage over those without when competition exists between them.

The various causes, internal and external, leading to lack of productivity are reviewed and discussed. Among the former the main are polyploidy and incompatibility ; the reduction division is described in some detail for various diploid species of *Prunus* and *Amygdalus*. A special study was made of the local cherry Saco, which displays all the characteristics of the Bigarreaux ; it seemed, however, to be a diploid with perfectly regular meiosis. All the cherry varieties examined contained a small proportion of binucleate pollen mother cells but no aneuploidy was detected.

There follow similar descriptions for the polyploid *Prunus* species, a hexaploid plum Rainha Cláudia (*Prunus domestica*) shewing 24 diploid chromosomes, with various secondary postsynaptic associations. Certain irregularities in division occurred, resulting in reduced fertility. Similar, but more pronounced, irregularities were observed in the variety Garrafal, a tetraploid of the Duke cherry type.

The *Pomoideae* are next described, starting with apple varieties, in which meiosis is entirely regular, 17 bivalents being regularly present at metaphase, with clear evidence of secondary association ; the lowest number of groups observed was 9—3 hexavalents, 2 quadrivalents and 4 bivalents in the variety Pipo. This evidence is not therefore altogether in support of the theory of secondary polyploidy. Secondary association was also observed in the second reduction division.

All the diploid varieties were of high fertility.

Various varieties characterized by irregular meiosis are next described. The identical behaviour of some of these suggested that they were synonyms. The variety Carneira proved to be triploid and in metaphase I displayed two hexavalents, 2 quadrivalents, 5 trivalents, 7 bivalents and 2 univalents (=51) ; or 3 quadrivalents, 5 trivalents, 11 bivalents and 2 univalents (=51) ; or 1 hexavalent, 5 quadrivalents, 3 trivalents, 7 bivalents, and 2 univalents (=51), etc.

Univalents were nearly always at the periphery of the plate. One to four, occasionally 7, univalents retarded or omitted division.

Various irregularities were observed at anaphase and even in the second division, leading to a number of micronuclei and irregular pollen formation. These varieties all displayed reduced fertility.
Twelve diploid pears proved to be exactly similar to the diploid apples in meiosis, including their evidences of secondary association. The three others, Leitão, Sete cotovelos and Beurré Alexandre Lucas shewed considerable chromosomal irregularity ; the last-named had 24 bivalents and 3 univalents and was thought to be a hyper-triploid. The number of chromosomes in the second reduction division in Sete cotovelos varied from 17 to 26. The metaphase in the first two varieties was similar to that in the last, 1 to 9 lagging univalents being observed, in this case the higher numbers predominated. Micronuclei and irregular microspores resulted ; these two varieties are thought to be triploids.
The author goes on to point out how the sterility of many varieties of *Prunus*, for example, is due to their hybrid origin after which the question of incompatibility and its inheritance is discussed briefly, with reference to the work of various authors in cherries (*Prunus avium*), Duke cherries (*P. Cerasus* or *P. avium duracina* x *P. Cerasus*), plums, almonds, pears and apples.
Charts are given shewing the time of flowering of the most common varieties grown in Portugal, based on observations made in 1932.
The remaining sections consist of discussions of various other factors which influence productivity, such as nutritional factors, vegetative propagation, morphological defects or characters (such as dichogamy, heterostyly, etc.) influencing fertilization, various external and climatic effects, and fruit drop ; there follows an outline of a programme for investigating the characters and fertility relationships of the main Portuguese fruit trees, determining which varieties are self-fertile and can be profitably cultivated without artificial pollination, which are self-incompatible and inter-incompatible, recording the time and duration of flowering, and the best pollinators for particular varieties, together with more general studies on sterility, and certain special problems such as metaxenia in the almond and the lack of productivity in the almond Côca. In the remarks on carrying out this programme the author gives indications of the technique to be employed in emasculation and pollination, collection and preservation of pollen and tests of pollen germination.

223. Sax, K. 634.1:576.356.5
Chromosome relationships in the *Pomoideae*.
J. Arnold Arb. 1932 : **13** : 363–67.
Various triploid hybrids between different species of the *Pomoideae* are mentioned in which round about 12 univalents are present, the nuclear behaviour in general shewing an entire lack of pairing between the extra 17 chromosomes. In this the author finds proof that the *Pomoideae* are not autopolyploids from a primary basic number of 7 and regards allopolyploidy resulting from duplication of a hybrid between an 8 and a 9 chromosome species as a more probable origin. The affinity between the two species would account for a certain amount of secondary pairing.

224. Bregger, J. T. 634.1/8:575.25
Present status of mutation studies in deciduous fruit varieties.
Proc. Amer. Soc. Hort. Sci. 1932 : **29** : 144–50.
The value of somatic mutations in improving the deciduous fruit varieties is now acknowledged by practical horticulturists. Mutations which may increase the value of the variety include those which affect the colour and time of coloration of the fruit, size, time of blossoming and ripening, and russeting. Sports would seem to occur within a variety in proportion to the amount of that variety grown and become more frequent as the search for them becomes more intense.
The actual mechanism is not yet accurately known but in the case of colour at least it is probably of a complex nature.
The production of bud sports experimentally seems likely to have good results and is stimulated by the protection afforded by the Plant Patent Act.

225. BRANSCHEIDT, P. 634.1/2:581.162.3
Weitere Beiträge zur Frage der Fertilitätsverhältnisse bei Kern- und Steinobstsorten. (**Further contributions to the question of the fertility relations in pome and stone fruits**).
Gartenbauwiss. 1933 : **7** : 546–66.
The slight tendency to self-fertility in pome fruits though interesting genetically has no practical value. The different germination percentages of the pollen of two trees of the apple " Landsberger Renette " and the different results obtained in pollinating the same tree of " Schöner von Boskoop " suggests that this variety is not a genetically pure individual variety but behaves like the pear " Gute Luise."
A high tendency to parthenocarpy was noticed in the pear " Neue Poiteau." The sweet cherries investigated were self-sterile, the sour cherries self-fertile.

226. LANTZ, H. L. 634.11:575.12
Apple breeding : A study on seedling fruits produced by Longfield.
Proc. Amer. Soc. Hort. Sci. 1932 : **29** : 139–43.
The variety Longfield was crossed with Gano, McIntosh, Mr. Beet and Ben Davis. The inheritance of size, form, colour and flesh characters was studied among the progeny. Only two seedlings from among the McIntosh x Longfield progeny were regarded as worth naming. These varieties Maud and Sharon, are considered as suitable for climates such as that of the central and northern half of Iowa.
The data on size suggest that this may be a heritable quality.
Multiple factors determine form and colour which shews a complex inheritance. Each flesh characteristic is apparently determined by a complex set of factors as is also season of ripening.

227. RUDLOFF, C. F. 634.11:575.252
Winter-Goldparmäne und zwei ihrer Sprossmutanten. (**Winter Golden Pearmain and two of its bud mutants**).
Züchter 1933 : **5** : p. 180.
Two bud mutants are illustrated, one being later in ripening and without the golden colour, the other resembling a tartarous, rough-skinned Reinette. The variety appears to be particularly prone to vegetative mutation.

228. ADATI, S. 634.11:576.312.35
Untersuchungen über die Chromosomenzahlen bei asiatischen wilden *Pyrus*-Arten. (**Investigation on the chromosome numbers of wild species of Asiatic *Pyrus***).
Cytologia 1933 : **4** : 182–88.
Seventeen was found to be the haploid number of the thirteen species investigated. As a result of his observations the author supports the view of Sax in regarding the *Pomoideae* as allopolyploids with the sum of the basic numbers 8 and 9 as their basis and finds no evidence for the contrary views of Darlington and Moffett.

229. NEBEL, B. R. 634.11:576.356.4
Chromosome numbers in aneuploid apple seedlings.
Tech. Bull. N.Y. Agric. Expt. Sta. 1933 : No. 209 : Pp. 12.
Examination of root tips from 103 apple seedlings of diploid x triploid, triploid x diploid and triploid x triploid varieties of apples shewed the progeny to be aneuploids exclusively. The crosses and resulting chromosome numbers are tabulated.
The sum of the observations on chromosome number is combined in one polygon which (if the chromosome numbers obtained can be used to elucidate the primary basic chromosome number

of the *Pomoideae*) should exhibit instead of a normal frequency curve, peaks at those points which correspond to multiples of the primary basic number or combinations of it and its multiples with derivatives of the secondary haploid number. On testing this hypothesis with multiples of 7 and of 8 the curve for 7 (as the basic haploid number) coincided relatively well with the abnormally high points of the observed frequency polygon.
The aneuploids obtained were of no practical value.

230. MacDaniels, L. H. and Burrell, A. B. 634.11:581.162.3
The value of the pollen of some of the recently introduced apple varieties.
Proc. Amer. Soc. Hort. Sci. 1932 : **29** : 151–55.
The results are given of pollinating McIntosh, Rhode Island Greening, Northern Spy and Cortland with a number of other varieties by the branch-unit method.

231. Gardner, V. R., Crist, J. W., and Gibson, R. E. 634.13:575.252
Somatic segregation in a sectorial chimera of the Bartlett pear.
J. Agric. Res. 1933 : **46** : 1047–57.
A limb sport is described which bears fruits with alternating vertical stripes of yellow and green both in the fruits and young shoots. Buds taken from shoots of this type gave inferior scions, very markedly so when they were obtained from regions in which the yellow predominated. Chlorophyll analyses shewed them to contain a lower proportion of all three pigments, especially of the green, in the bark and somewhat less in the leaves.
An examination of a large number of scions shewed that segregation is continually taking place on these mixed shoots and that it occurs at the nodes ; a strip of tissue of one colour or the other may change to the reverse colour in the succeeding node. The same variation is observed in the fruits of successive spurs of the fruiting branches.
Fruit form was subject to a similar variation, independent of the variation in colour.
The maintenance of the type is only possible therefore by rigidly selecting the bud wood.

232. 634.2:575.127.2:581.331.2
Becker, C. L. 634.2:581.162.32
Studies of pollen germination of certain species and interspecific hybrids of *Prunus*.
Proc. Amer. Soc. Hort. Sci. 1932 : **29** : 122–26.
In order to ascertain the relationship, if any, between cross-sterility in hybrid plums and cold weather, the germination and growth capacity of pollen of different varieties at low temperatures was investigated.
Most of the Minnesota hybrid plums produce abundant pollen but the viability is low and few can be regarded as dependable pollinators. Native plum varieties produced only fair pollen. As regards temperature, at 10°C. the germination of all varieties tested was lower than at higher temperatures. The rate of pollen tube growth was markedly affected by temperature, and at 10°C., the lowest temperature at which plum pollen germinated within 24 hours the tubes were very short. At 13°C. growth was much more rapid and at room temperature long tubes were obtained in 24 hours.
Though the relation of the age of pollen to germination and pollen tube growth was not determined by exact counts, in general the viability percentage decreased as the age increased. Age also affected the vigour of pollen tube growth.

233. 634.2:575.127.2:581.47
Angelo, E. and Alderman, W. H. 634.2:575.127.2:581.45
Fruit and leaf characters in interspecific hybrids of *Prunus*.
Proc. Amer. Soc. Hort. Sci. 1932 : **29** : 115–17.
Controlled crosses of various *Prunus* species were made, and in the F_1 from *P. salicina* x *P. americana* and its reciprocal both the parental types and intermediate types of leaf and fruit appeared ; while on crossing *P. nigra* with *P. salicina* no *salicina* leaf types were obtained, only

nigra and intermediate forms occurring when *P. salicina* was used as the ♂ parent. The reciprocal however, gave the two parental and intermediate types. From the data for these two groups of crosses it is concluded that the female parent exerts " some maternal influence " on the progeny and that the percentage of parental types in the progeny is influenced by the species used as the maternal parent.
The author holds that only intermediate types would be expected in the F_1 from crosses of two pure species and he is therefore led to conclude that in the above material the species are closely related and also extremely heterozygous for the leaf and fruit type characters.
In view of the similarity of the grouping of the parental and intermediate leaf types in the F_2 of a (*P. salicina* x *P. americana*) x (*P. salicina* x *P. americana*) cross to the grouping in F_1 of these species the production of an F_2 is regarded as unnecessary in practical breeding.

234. RUDLOFF, C. F. and SCHANDERL, H. 634.22:581.162.3
Befruchtungsbiologische Studien an Zwetschen, Pflaumen, Mirabellen und Reineclauden. I. **(Studies in the biology of pollination in plums, mirabelles and greengages I.**
Gartenbauwiss. 1933 : **7** : 421–57.
Investigations were made on 33 varieties, 10 were self-sterile, 11 partially self-fertile, 10 self-fertile and 2, Grosse grüne Reineclaude and Mirabelle von Metz, were self-fertile in one year and self-sterile the others.
Variations were found in the resistance of the reproductive organs, especially the female, to unfavourable climatic conditions in some of the varieties.

235. ALDERMAN, W. H. and ANGELO, E. 634.22:581.162.5
Self and cross-sterility in plum hybrids.
Proc. Amer. Soc. Hort. Sci. 1932 : **29** : 118–21..
Nearly all combinations of inter-crosses were made between 7 of the main varieties of plum in Minnesota and in addition these 7 varieties were also pollinated by 7 others. Pollinations numbering 43,000 were made and the various percentages of fruit set shewed that the effectiveness of a pollinator varies on different varieties. In this limited test, however, the variety Surprise found a place among the " most effective pollenizer " group for all the varieties on which it was used ; but its percentage set ranged from 2·4 on Elliot to 16·7 on Red Wing. [Given as 13·5 per cent in the table].
The seven main varieties when intercrossed proved almost entirely worthless as pollinators, but the native varieties Surprise, Rollingstone, De Soto and Wolf were with few exceptions fair to good pollinators wherever used. Hanska, Kaga and Superior, the three hybrids used as pollinators only, proved much more effective than any of the original seven varieties used for intercrossing. This superiority is attributed to the presence of *P. Simonii*, the Chinese apricot-plum in their pedigrees. Moreover, the only hybrids in the " most effective " or " fair pollenizer " groups were also related in some degree to *P. Simonii*. It is hoped that further research on the hybrids of this species may result in the discovery of effective pollinators for commercial varieties. Such Oriental-American hybrid pollinators would be desirable not only because of the valuable fruit they produce but also because of the tendency of the hybrid varieties to bloom about the same time.

236. EINSET, O. 634.23:581.162.3
Experiments in cherry pollination.
Bull. N.Y. Agric. Expt. Sta. 1932 : No. 617 : Pp. 13.
The results of isolated self-pollination and cross-pollination in a large number of varieties are described. All the sweet cherries tested were apparently self-unfruitful and were most effectively cross-pollinated by sweet varieties. Conditions of fruitfulness in the Duke cherries which form an intermediate group between sweet and sour varieties were investigated.

237. PHILP, G. L. 634.23:581.466
Abnormality in sweet cherry blossoms and fruit.
Bot. Gaz. 1933 : **94** : 815–20.

In the sweet cherry (*Prunus avium*) an anomaly in flower structure has been observed in American orchards in certain districts in 1932. The styles were protruding from the unopened flowers and were found to be attached to or protrude through the stamen filaments. Nearly all abnormal flowers contained double pistils which developed into double or malformed fruits, though fruit counts shewed that many otherwise normal blossoms contained double pistils. The Bing variety shewed 119 abnormal blossoms and five double fruits, 11 malformed and no normal fruits, whilst the Napoleon variety shewed 234 abnormals which resulted in 1 normal fruit, 1 double and 18 malformed.

The tendency to produce abnormal flowers varies from year to year, and also seems to be greatest at the ends of branches. It seems probable from the survey made of seven counties that this defect in flowers and fruits may be associated with high temperatures. The phenomenon was also observed in *Prunus cerasus* (Montmorency).

238. BAILEY, J. S. and FRENCH, A. P. 634.25:575.11
The inheritance of certain characters in the peach.
Proc. Amer. Soc. Hort. Sci. 1932 : **29** : 127–30.

A genetical analysis of certain characters shewed that the albino seedlings which appeared among the progeny of the selfed variety Champion behaved as simple recessives to normal. The inheritance of foliar glands was the same as found by Connors, i.e. the reniform type was dominant, eglandular recessive and globose intermediate. An unusual combination of very waxy leaves with very sharply serrate margins and globose glands occurred.

Melting flesh behaved as a simple dominant to non-melting and free stone adhesion to clingstone. In certain varieties there was linkage between the free-cling characters and the melting-non-melting characters with about 8 per cent of crossing over.

Other data suggest that more than one pair of genes determines toughness of flesh.

239. BLAKE, M. A. 634.25:575.11
The J. H. Hale peach as a parent in peach crosses.
Proc. Amer. Soc. Hort. Sci. 1932 : **29** : 131–36.

A number of crosses with the J. H. Hale peach as the female parent shewed that most of the characters of this variety are recessive. The evidence suggests that the J. H. Hale may be regarded as a recessive variant of Elberta.

Dominance of the following characters was established as a result of the experiments : red flesh colour of the pit over its absence, watery melting flesh over firm melting flesh, blood-red flesh over the absence of red, heavy pubescence over short or light pubescence, oval-conic, oval-oblong and round but pointed forms over round, early blooming over late blooming, vigorous sucker development over slight sucker development. Non-melting flesh was recessive to both watery melting and firm melting flesh, and full dwarf and semi-dwarf habit of growth were recessive to normal.

240. 634.3:575.76
SWINGLE, W. T. 575.172.1
Neophyosis or rejuvenescence of nucellar bud seedlings in *Citrus*.
Amer. J. Bot. 1932 : **19** : p. 839. (Abst.).

A relationship between hormones and gene action is suggested as the explanation of the rejuvenescence phenomenon.

241. LUSS, A. I. 634.3:581.143.26.03
(A contribution to the question of accelerating fructification in the seedlings of trees and shrubs.)
Bull. Appl. Bot. Leningrad 1933 : Ser. A (5–6) : 102–05.

Seedlings of various citrus hybrids flowered in the second year of life and the phenomenon is ascribed to the action of the low temperature to which they were subjected, some sort of " vernalization " having occurred.

242. Shamel, A. D. and Pomeroy, C. S. 634.31 Washington Navel
The Washington Navel orange.
Citrus Pub. Riverside Chamb. Comm. 1933 : No. 3 : Pp. 32.

Shamel, A. D.
History of origin and introduction of the Washington Navel Orange.
Calif. Citrogr. 1933 : p. 171.
Though of obscure origin the Washington Navel orange is generally believed to have been first propagated about 1820 in Bahia, Brazil. It probably arose as a bud sport from the Selecta orange, a variety of Indian origin which also tends to produce navel fruits.
The general technical and economic aspects of cultivation and the value of individual tree performance records in comparing varieties, strains and progenies is pointed out.

243. Tanaka, T. 634.324
(General remarks on the genus *Fortunella*.)
Studia Citrologica 1933 : **6** : 19–40.
An account of the genus, with descriptions of two new species.

244. Serrano, F. B. and Palo, M. A. 634.441–2.7
Blossom-blight of mangos in the Philippines.
Philipp. J. Sci. 1933 : **50** : 211–77.
The causative hopper, *Idiocerus* sp., its ravages and the effects of various sprays are described at length and amply illustrated.
The article concludes with emphatic advice to attempt the production of resistant types by crossing the carabao mango with the resistant pahutan.

245. Wood, M. N. 634.51:581.162.3
Dichogamy—An important factor affecting production in the Persian walnut.
Proc. Amer. Soc. Hort. Sci. 1932 : **29** : 160–63.
As a result of investigations all the varieties were found to be self-fertile and inter-fertile ; inter-fertility was also found between *Juglans regia* and a number of other species.
Dichogamy was common and varied greatly in extent and in type. Some varieties are protandrous and some protogynous and dichogamy is affected by the age of the tree, by climatic conditions (which affects protandrous and protogynous varieties differently) and locality.
Successful pollination can only be secured by some form of grouping, in preference one based on a knowledge of the effect of local conditions on the varieties. A combination of intermediate with early and late bloomers or all three is probably best.

246. Wood, M. N. 634.51:581.162.3:578.08
Artificial pollination as a means of increasing production in commercial Persian walnut orchards.
Proc. Amer. Soc. Hort. Sci. 1932 : **29** : 164–68.
A method has been devised of artificially pollinating dichogamous Persian walnuts by means of catkins gathered at all stages of maturity and suspended in mosquito net bags in the tops of the trees for pollination. The following requirements are essential for success :—(1) There must be enough trees producing catkins at the time when the pistils of the variety to be pollinated are receptive ; (2) weather must be conducive to pollen shedding, and there must also be air currents to carry the pollen ; (3) sufficient pollen must be provided to ensure efficient distribution over most of the pistillate blooming period.
The method, when tested in four orchards in 1931 and 1932, resulted in an increased yield in both years, though the weather in 1932 was very unfavourable to pollination. The increase ranged from 141·1 to 3,084 pounds per acre.
Where cheap labour is available for the initial work and for the daily tapping of the suspended bags of catkins the expense is small.

247. STOUT, A. B. 634.653:581.162.3
The pollination of avocados.
Bull. Fla. Agric. Expt. Sta. 1933 : No. 257 ; Pp. 44.

A study of pollination in the avocado is of special importance owing to the existence of the two groups of seedlings and clonal varieties namely the A and B groups, the former having flowers which behave as ♀ ♀ in the morning and as ♂ ♂ in the afternoon and the latter group being characterized by exactly opposite behaviour. The first and second openings occur on different days and at different hours of the day which naturally restricts self, close and cross-pollination especially when vegetative propagation and block planting of group A or B are practised. Following a detailed description of flower behaviour in the two groups a useful table of the A and B varieties is given. The relative flower behaviour of different varieties with reference to the exact time of day when the two sets open and close and its bearing on reciprocal pollinations is considered.

Varietal differences have been found to exist within the groups A and B as regards the time of opening and closing. Apparently any B variety provides pollen at a time suitable for any A variety ; but the chances of pollination of those B varieties whose period of opening is late in the afternoon are reduced by the fact that pollen shedding has by this time almost ceased in the A varieties. The question of abnormal flower behaviour in general and also in different varieties, such as single opening, delayed opening, reversal of daily alternation and extended cycles, due to extremes of weather and especially temperature changes is fully discussed and the behaviour for an orchard of the Trapp variety throughout the season of flowering in 1925 is recorded.

Self-pollination of individual flowers can only occur during the normal second period of dianthesis or during a single opening when pollen is being shed. The B varieties with the shortest cycles such as Trapp and Pollock would be most likely to set fruit to self or cross-pollinations by other B varieties during the second period of the cycle, i.e. on the following day ; whereas in general A varieties must be pollinated during their first opening, and this applies also to B varieties with long cycles of 48 hours. Close pollinations may occur (1) between different flowers all of which are shedding pollen and (2) when first-period flowers receive pollen from flowers in the second period, i.e. dichogamous close pollination. Though (1) above may occur at all times it does not in many varieties lead to the setting of fruit. Dichogamous close pollination might occur during an overlap of two sets—which is very rare—or as a result of insects forcing flowers during the interval after the first opening, or finally during the various irregular types of flower behaviour. As regards fertilization, the pistils are apparently most receptive to pollination during the first opening, though it is possible that many flowers on certain varieties may remain more or less receptive until the second opening. Still little is known of the process of fertilization or of the possible role of compatibility and cross pollination in the production of fruit.

Structural abnormalities of certain pistils have been found and it seems that few pollen tubes or possibly only one can penetrate through the style. The seedless fruits produced by certain varieties may be due to parthenocarpy or the death of the embryos after fertilization. The occurrence of apogamy is held to be unlikely. The excessively poor results from self, close and cross-pollinations by hand were in marked contrast to abundant setting of fruit due to open pollination by insects, under the same conditions. Tented tree investigations also shewed that cross-pollination is necessary—a view further borne out by the high yield of the pollen-sterile Collinson variety when cross-pollinated. As a means of ensuring cross-pollination inter-planting is advocated and fully discussed and suggestions for future investigations are outlined. Remarks are made on other environmental factors such as methods of cultivation, weather conditions, etc

248. *ROSANOVA, M. A. 634.7.00.15(47)
(Results and prospects of scientific research in the field of small fruit growing).
Bull. Appl. Bot. Leningrad 1932 : Ser. A (4) : 71–76.

Early attempts, mainly sporadic, some successful, in breeding, small fruits are briefly referred to. The present investigations aim at collecting and studying all existing forms and selecting those

* An abridged translation of this paper is on file at the Bureau.

best suited to each individual zone and the special demands of different districts and further to improve them by breeding and genetics. The Institute of Plant Industry now possesses 1,000 varietal specimens in addition to 2,000 wild forms and the genetic material and from these the 70 best-have been selected for trial in various regions.
Forms of various fruits characterized by greater earliness, productivity, resistance to cold, drought or disease have been found amongst the material, together with such interesting forms as bisexual strawberries and soft-spined *Rubus* species.
The north of the Soviet Union contains a wealth of Vacciniums, the Caucasus, Siberia and the Altai mountains of *Rubus* and gooseberries, and the Far East is rich in raspberries, *Actinidia* and edible honeysuckle. By utilizing these forms for introduction and breeding it should be possible to produce types far more successful than the varieties imported from abroad.
The major problem is to extend cultivation northward and into the drought regions. Earliness and resistance to cold and drought are required for this. Crosses are being made between varieties already resistant to cold in the hope of increasing this character.
Further problems under investigation are the inheritance of agronomic characters, the capacity of the different species to hybridize with other nearly related and more distant species, the problem of sex as illustrated by monosexual species such as the garden strawberry and the artificial production of mutations. Great hope is centred on interspecific crosses in such genera as *Fragaria* and *Rubus* and search is being made for the most favourable initial material. Crossing between different forms of the same species also offers great possibilities.

249. GUSTAFSSON, Å. 634.71:576.16:576.356.5:581.163
Zur Entstehungsgeschichte des *Rubus Bellardii* Whe. and N. (**The history of the origin of *Rubus Bellardii*. Whe and N.**)
Bot. Notiser 1933 : 231–47.

Rubus Bellardii is a characteristic and well-defined species, with few variants and very few hybrids. It forms however a certain proportion of misshapen pollen grains and cytological observations of the author have shewn it to be pentaploid (2n=35), in distinction from all the other *Rubi Eubati* which are tetraploid. The number 35 was confirmed in innumerable root-tip examinations. A rough characterization of the different types of chromosomes observed is given. Five chromosomes with satellites were present, three being identical and distinct from the other two.
The reduction division was typical of a pentaploid hybrid ; gemini formation was common, with not infrequent polyvalent formation, though complexes with more than five were never seen. Secondary chromosome association, with a maximum number of associates of five, was of frequent occurrence. The percentage of morphologically good pollen formed amounted to 50—60 per cent.
The species occurs in Central and Southern Europe in conjunction with various other species. It is probable that it has arisen comparatively recently by hybridization, two partially unreduced gametes having united. Its high chromosome number, marked resistance to cold and wind and its general vigour account for its present extensive area.
Thirteen plants obtained by pollination with *R. tomentosus* were all identical with the maternal plant and had 35 chromosomes, indicating that the species is apomictic. It is still capable of functioning as a pollen parent but it is thought that it will in the course of time become the source of a number of vegetative microspecies and so give rise to an entirely apomictic species which on account of its greater ecological adaptation will gradually suppress the others.
Many of the apomictic species have probably arisen in this way, by a particularly favourable gene combination followed by increase in chromosome number, and the development of a number of forms which gradually replace the parental species.

250. GUSTAFSSON, Å. 634.71:576.312.35
Chromosomenzahlen in der Gattung *Rubus*. (**Chromosome numbers in the genus *Rubus*.**)
Hereditas 1933 : **18** : 77–80.

In connexion with the facultative apomixis, in which the European forms differ from the American ones, it is pointed out that no wild triploid forms have been found in Europe, evidently

owing to the infrequency of crossing between sexual diploids and the apomictic tetraploids or the production, when such a cross occurs, of unreduced egg cells, giving rise to forms with a higher selection value.
The species studied are grouped into diploid, tetraploid, pentaploid, hexaploid, heptaploid and aneuploid forms. Of the latter only one occurred, *R. aluxatus* Neum. var. *subnitidus* Lidf., with 2n = 45 and this conclusion was based only on the examination of one plate. The basic number 7 was confirmed.

251. YEAGER, A. F. and LATZKE, E. 634.72:575(78.4)
Gooseberries. Varieties, breeding, culture and use.
Bull. N. Dak. Agric. Expt. Sta. 1933 : No. 267 : Pp. 19.
A short historical introduction on gooseberry varieties in America is followed by a description of crosses begun in 1920, between the native wild gooseberry *Ribes missouriensis* and several American cultivated varieties. Of these crosses one, Oregon Champion x *R. missouriensis* yielded plants that were nearly all strong, vigorous, hardy and fruitful and so superior that 14 selected seedlings were tested under propagation in 1932, and the following 3 subsequently named and distributed to growers : Pixwell (N.D. No. 9), Abundance (N.D. No. 7), Perry (N.D. No. 3). All were remarkable for productivity especially " Abundance." Four hundred seedlings have been raised from these varieties and breeding and selection are still in progress with a view to further tests of certain types as fruit producers and of other kinds as ornamental hedge shrubs. An attempt was made to obtain greater drought resistance from the cross Oregon Champion x *Ribes setosum*, and their wild form, but so far the progeny have been of no value.
Indications for the following genetic relationships were found in the course of these experiments : red fruit colour is dominant to green ; smooth fruit to downy fruit ; long pedicel and peduncle to short pedicel and peduncle, though apparently due to the action of more than one factor. Oregon Champion was apparently heterozygous for the dominant factor for dwarf habit, and was apparently heterozygous for a dominant factor for the light green of unripe fruit as compared with the dark green of the American wild gooseberry.

252. TROCHAIN, Y. 634.73
Les *Vaccinium* comestibles. (**Edible forms of *Vaccinium*.**)
Rev. Bot. Appl. Agric. Trop. 1933 : 13 : 173–89, 268–75, 319–29.
The genus *Vaccinium* and the genus *Oxycoccos*, which is included by certain American writers in the genus *Vaccinium*, are described, including a description of the species *V. macrocarpum* Ait. and its chemical composition and acid content. The remainder of the paper is devoted to a description of the cultivation of the above mentioned species in U.S.A. *V. corymbosum* is similarly treated.
The second portion of the paper deals with the diseases and insect pests of edible *Vaccinium*. In the third section the edible wild forms of *Vaccinium* are briefly described under the headings European, Asiatic, African and American. A bibliography of 54 references grouped under main heads is appended.

253. 634.73:576.16:576.356.5
HAGERUP, O. 576.356.5:578.088:581.036.5
Studies on polyploid ecotypes in *Vaccinium uliginosum* L.
Hereditas 1933 : 18 : 122–28.
An arctic ecotype of *V. uliginosum* has been discovered in East Greenland at 70° N. lat., differing from the Danish type in having short shoots, procumbent habit, slender stem and very small leaves, though at the same time exhibiting such close agreement with the European forms of the species (f. *genuina* Herd.) that the author has called it f. *microphylla* (=var. *alpinum* Bigel.). That the new type cannot be entirely due to climatic influences is shewn by the discovery by Bocher (1932) of both f. *genuina* and f. *microphylla* growing at 66½° N. lat. in East Greenland. Cytological comparison of the two forms from the arctic shewed f. *genuina* to be a tetraploid form within the species, (n=24) while f. *microphylla* was diploid (n=12). The arctic dwarf form is more fertile than the Danish type probably because f. *microphylla* is self-pollinating.

The two forms in question occur together only round the polar regions, the diploid being more frequent in the arctic than is the tetraploid.
V. uliginosum is thus an example from nature of a change in ecological adaptation of a plant, as a result of polyploidy, and is also an interesting exception to the general rule that the forms with the highest number of chromosomes are the most hardy.
Finally, it is interesting to consider that since polyploidy may arise through unfavourable external environment and may have an indirect influence in the formation of new species hence environment may be a considerable factor in species formation.

254. LILIENFELD, F. A. 634.75:575.127.2:576.356.5
Karyologische und genetische Studien an *Fragaria*. I. Ein tetraploider fertiler Bastard zwischen *F. nipponica* (n = 7) und *F. elatior* (n = 21) **[Karyological and genetic studies on *Fragaria* I. A tetraploid fertile hybrid between *F. nipponica* (n = 7) and *F. elatior* (n = 21)]**
Jap. J. Bot. 1933 : 6 : 425–58.
In contradistinction to the failure of previous crosses between diploid species and *F. elatior*, the combination *F. elatior* x *F. nipponica* was relatively successful; 50 achenes, out of 189 produced, germinated and gave rise to 44 healthy plants. Though slightly less vigorous these were in all other respects identical with *F. elatior*, except in the possession of 28 chromosomes. Thirteen of the plants flowered, 6 being female and 7 male ; the pollen was good and the females fertile. In other crosses also *F. elatior* has proved to have a high proportion of dominant genes.
Meiosis in pollen mother cells was almost regular, with 14 bivalents at metaphase. Tetravalents were not infrequent, two being sometimes present in one pollen mother cell, one consisting of smaller units than the other, and occasionally three were present ; two univalents were observed at times. From this behaviour it is apparent that the *nipponica* genom is homologous with one of the *elatior* genoms, the other two of which are homologous and pair autosyndetically, having also a certain degree of homology with the first.
All but one of the seeds produced in the reciprocal cross failed to germinate, this one plant also resembled *F. elatior* but less so than the direct cross. The plant was much more vigorous. Its somatic chromosome number proved to be 35 and this together with its greater resemblance to *F. nipponica* indicates the presence of two genoms, resulting from the fertilization of a diploid egg cell. The plant was male but the pollen quality was lower than the reciprocal ; using it in backcrosses, only the one with *F. elatior* succeeded.
At metaphase I, 14 bivalents and 7 univalents were usually seen, though the number of univalents varied from 5 to 7, tetravalants being again not infrequent. The univalents mostly did not divide, sometimes shewed irregular segmentation, and had a tendency to group together.
Tetraploid F_1 males and females were crossed and produced 660 seeds, from which 499 seedlings and 319 healthy plants were produced. The F_2 was the scene of most heterogeneous segregation, the characters of the two parents being distributed independently. The F_1 type was the most frequent, plants resembling *F. elatior* were relatively common, those resembling *F. nipponica* however rare. Many entirely new combinations also appeared, some of which shewed transgression of parental characters.
Most F_2 plants had 28 chromosomes but one *chlorina* dwarf had 27 + 1 fragment, and 1 large-leaved plant proved to have 42, indicating its origin from the union of an unreduced with a reduced gamete. The interest of producing a fertile segregating progeny with a new chromosome number from two parents differing in chromosome number is pointed out. No tetravalent formation has been observed in *F. elatior* itself and it is possible that the 2 genoms which pair autosyndetically in the hybrids never pair in the pure species. The new combinations of characters made possible by this new type of pairing are a further source of heterogeneity, over and above that resulting from the heterozygosity of the parents and the number of characters in which they differ. The production of fertile segregating hybrids of this type is naturally limited by the occurrence of autopolyploidy in the highest chromosome parent.
Backcrosses of the tetraploid with *F. elatior* pollen were perfectly successful, the reciprocal slightly less so. The progeny was more vigorous than the F_2, displayed dominance of *F. elatior*

leaf type and had mostly 35 chromosomes, though one individual occurred with 36 and 37 in different root tip cells.
F. elatior pollinated with the pentaploid F_1 gave very few seeds and the two plants produced each had 35 chromosomes, indicating a greater activity of the 14 chromosome pollen grains. Backcross progenies with *F. nipponica* female were feeble, though 8 strong plants were procured, 3 of which when examined displayed the expected 21 chromosomes. The reciprocal failed entirely.
Self-pollinations of *F. nipponica* succeeded only with extreme difficulty and only very feeble plants were obtained. The various sex relationships to be expected in later generations are discussed at some length. These will depend largely on whether the genom which pairs with the *nipponica* genom is homologous in all respects with the other genoms, i.e. whether the hybrids are autopolyploid.
The author doubts the correctness of the observations of Yarnell of complete pairing in a hybrid between diploid and octoploid species.
In general the crosses succeeded better when the higher chromosome parent was used as mother, though this was not always the case.
The F_2 and backcrosses contained a number of dwarfs, which are ascribed mainly to special factorial combinations, occasionally to chromosome aberrations.

255. KERVEGANT, D. 634.771
Introduction à l'étude des variétés de bananiers à fruits comestibles de la Martinique. (**Introduction to the study of varieties of bananas with edible fruits of Martinique.**)
Rev. Bot. Appl. Agric. Trop. 1933 : **13** : 251–67, 337–46, 415–20.
In this paper a historical introduction is followed by a discussion on existing classification of bananas and on the necessity for cytological and genetic study. A full description of different varieties and sub-varieties of the banana and their various appellations and geographical distribution is given and where necessary prevailing errors in nomenclature are pointed out.
In conclusion the commercial possibilities of certain varieties are considered. A bibliography of 37 references completes the paper.

256. COLLINS, J. L. 634.774:576.356.5
Morphological and cytological characteristics of triploid pineapples.
Cytologia 1933 : **4** : 248–56.
This paper was read at the 6th International Congress of Genetics and is summarized in " Plant Breeding Abstracts," Vol. III, Abst. 512.

257. PEARSON, H. M. 634.8:581.163:575
Parthenocarpy and seed abortion in *Vitis vinifera*.
Proc. Amer. Soc. Hort. Sci. 1932 : **29** : 169–75.
The types of parthenocarpy in Red and White Corinth and Black Corinth and seed abortion in Sultanina, Sultana and Monukka are described. Occasional seeds of Black Corinth have germinated and embryos were found by the author in seeds of Sultanina.
The seedless type occurs so frequently in crosses of the Sultanina type that it is assumed to depend on comparatively few factors and breeding for the character should therefore not be difficult.

258. PETRI, L. 634.8–2.8–1.521.6:575
Sopra la opportunità de applicare le odierne nozioni della genetica alla produzione di nuovi portinnesti per la vite europea. (**On the opportunity to apply the modern ideas of genetics to the production of new stocks for European vines.**)
Boll. Staz. Patol. Veg. Roma 1932 : (N.S.) **12** : 343–60.
A disease which is described as a gradual exhaustion and is known as premature senescence is attacking the Italian vines. At present neither the precise nature of the disease nor the agent

is known. It may prove to be due to a virus but further experiments and observations are needed.
The fact that the vines attacked are grafted on American stocks suggests that these may be ill-adapted to the European conditions and it is urged that genetical research is needed to find resistant stocks, either direct producers, that are resistant to phylloxera and court noué, or hybrids with a certain amount of *vinifera* parentage.

259. Dorsey, M. J. 634.83:581.466
The morphological expression of dioeciousness in the grape.
Proc. 6th Int. Cong. Genet. 1932 : **1** : 372–73.
No case of germination or even the presence of a germ pore was observed in pollen from the reflexed type of stamens.
Examination of staminate and pistillate types shewed that fruit setting was sometimes prevented by imperfect stigma, sometimes by abortion of ovule or embryo sac. The intermediates sometimes approximate extremely closely to the hermaphroditic types.

260. Mat. F. 634.835.09(49.3)
Opzoeking van nieuwe variëteiten tafeldruiven. (**Selection of new varieties of dessert grapes**).
Agricultura Louvain 1933 : **36** : 1–8.
Since 1930 vine breeding in Belgium has been directed towards the production of (1) a new late maturing black variety by crossing Gros Colman (late and black with a bronze tinge) with Royal Emile (semi-late and bluish black) ; (2) a new golden yellow late variety by crossing Muscat d'Alexandrie (semi-late and golden) with Colman blanc (late and golden).
From 765 seeds obtained by hybridization in 1931, 162 hybrids of the black varieties and 36 hybrids of the yellow varieties were obtained. On genetic grounds the darker fruit colour is expected to predominate in both groups, and a large proportion of late maturing segregates and possibly even transgressive types superior to Gros Colman are anticipated.
The hybrids are tentatively stated to be promising but no definite results can be formulated yet.

261. Wellington, R. 634.84:575.127.2:634.85
Results obtained from crosses between Danugue (Gros Guillaume) and Ontario and Hubbard grape varieties.
Proc. Amer. Soc. Hort. Sci. 1932 : **29** : 137–38.
Both the Ontario and Hubbard varieties are hybrids of *V. vinifera*. The progeny which survived from the crosses described all shewed their hybrid origin and although they still have to undergo further tests several of them are very promising and demonstrate the value of hybridizations between the American varieties and *V. vinifera*.

FORESTRY 634.9

262. 634.9(48.9)
634.972.1:575(48.9)
634.972.1:576.16(48.9)
Det forstlige Forsøgsvaesen i Danmark. Beretninger udgivne ved den forstlige Forsøgskommission. (**The Danish experimental forestry service. Reports with summaries in English.**)
Copenhagen 1932 : **12** : Pp. 400.
This monograph compiled mainly by the late Professor A. Oppermann deals with the morphological types and races of the oak, with special reference to Denmark. The development, spread and distribution of the oak forests, variations in tree types, the development of sylviculture in various ages and the origin and growth of the genetic view point are all treated fully and with the requisite historical and cultural background.

Of special interest is the chapter on the experimental sowings of oaks from acorns gathered in 1911. Samples numbering 90 from various regions were sown in 3 lots, then transplanted and observed for some years and type and growth recorded in 1922 and 1929 under the following classes :—Progeny of (a) good oak groves ; (b) of a few isolated, good trees ; (c) of inferior oak groves ; (d) of inferior isolated trees ; (e) of oak thicket and remains of forests ; (f) of foreign origin.

Group (a) was as a whole good, 50 per cent being good types. Group (b) was composed almost exclusively of superior types ; though in no case was the progeny entirely uniform and form and vigour shewed considerable variation in all plots. Group (c) was of poor quality. Group (d) represented a very heterogeneous inferior collection as regards form though a few cases of first class progeny did occur in this group, thus shewing that bad formation in a mother tree does not necessarily lead to inferior progeny. Group (e) appeared to consist of excellent material. The results in Group (f) were naturally varied ; indications were found that various races of *Quercus sessiliflora* and also of *Q. pedunculata* may differ in the time of coming into leaf.

Though the possibility of cross-fertilization precludes any definite conclusions as to inheritance, the following frequencies indicate the general trend of the observations as a whole, where A = predominantly good, B = good and bad trees mixed in approximately equal numbers, C = predominantly bad and D = bad only :—Progeny from good mother trees, A = 61 per cent, B = 25 per cent, C + D = 14 per cent ; from inferior mother trees, A = 15 per cent, B = 26 per cent and C + D = 59 per cent.

The data as a whole also seemed to indicate that good types were late in coming into leaf as compared with inferior types, and that the various races shew different relationships between form and time of leafing.

Environmental effects are also discussed.

263. KOLESNIKOV, A. I. 634.97:575"793"

(On the methods of obtaining rapidly growing forms.)

Bull. Appl. Bot. Leningrad 1933 : Ser. A (5–6) : 83–101.

The main objects of forest breeding in the Soviet Union are the creation of forms resistant to drought, cold, soil salts, diseases and pests, and forms suitable for special commercial purposes. In all cases rapidity of growth is one of the characters of most importance for successful growing. Various ways in which rapidity of growth can be increased are outlined. Experiments are quoted which shew that forest trees, just as other plants, consist of populations comprised of individuals differing in hereditary characters.

Ordinary methods of selection should therefore be efficacious. The advantages of hybridization are mentioned, including the phenomenon of heterosis, which increases the vigour of growth. Examples of various forest tree hybrids, natural and artificial, are mentioned, including various crosses by the author. Of these the hybrids of *Tilia americana* x *T. argentea* combined the rapid and vigorous growth of the former with the silver leaf of the latter ; *Quercus Robur* L. (*pedunculata*) x *Q. Macrocarpa* displayed greater rapidity of growth ; hybrids were obtained between various species of *Pinus*.

The possibility of inbreeding in many forest trees has been demonstrated by the author and the advantages of the method are enumerated. Among other things, rapid growth is recessive to medium and can be isolated by inbreeding.

Inbred oak seedlings at the age of one year were smaller than normal seedlings by 8 per cent, their coefficient of variability was 1½ times greater. These differences were much more pronounced in two-year-old seedlings, the difference in height amounting to 46·4 per cent and the coefficient of variation 2·2 times as great.

Together with many small inferior plants certain individuals considerably exceeded the maximum height for the controls (57·1 cm. as compared with 42·0).

Reference is made to many cases of mutation in forest trees, including various early mutants, and to the importance of polyploidy in the production of gigantism and the origin of new forms, as for instance the already known case of *Aesculus carnea* and many fruit trees.

Growers and investigators are urged to keep their eyes open for the possible appearance of new mutants and to undertake systematic investigations into the problems outlined above.

264. 634.97:575.42
CABIANCA, S. 634.97:581.162
New principles in the collection and preservation of forest seeds.
Int. Rev. Agric. Rome 1933 : **24** : 308–17.

In the regeneration of forests and the establishment of new plantations the selection of good seed bearers is of primary importance. In most cases the choice of mother trees is based upon an external examination on the assumption that the external characteristics and strength of the parent will ensure good seeds and similar qualities in the progeny. The validity of this assumption and also the possible variation in the effects of environmental phenomena are now being considered ; and it is interesting to note that studies of such relationships between mother and progeny in *Pinus resinosa* and also in *Betula lenta* and *Liriodendron tulipifera* have yielded results which appear to challenge the general view.

The physiological aspects of pollination and the non-genetic agencies also involved in it, as well as parthenocarpy, and other deviations from normal reproduction are now attracting attention ; and a special study of the periodicity of fruit bearing in certain conifers in Central Europe is being made in Germany.

The supposed influence of the position of fruits in the crown on the seeds, the relationship between seed quality and size of cone, seed preservation and methods for accelerating or regulating germination are discussed.

265. YARNELL, S. H. 634.972.1:575.127.2:575.11
Inheritance in an oak species hybrid.
J. Arnold Arb. 1933 : **14** : 68–75.

A study of the F_2 generation of the cross *Quercus virginiana* x *Q. lyrata* made by Helge Ness in 1909 and 1910. The hybrids themselves shew marked evidence of hybrid vigour.

According to leaf measurements the leaves of the F_2 plants fall into two more or less equal groups corresponding to each of the parental species. The two groups contained 12 and 11 individuals respectively from which a two factor ratio of 9 : 7 is deduced. Both parental leaf shapes were recovered in the F_2, from which it is argued that no more than two shape factors are operative. Almost all the large-leaved individuals had lyrate leaves and vice versa. Fifteen F_2 plants were coriaceous and eight non-coriaceous, which is again interpreted as a 9 : 7 ratio ; the F_1 was intermediate. All plants with large coriaceous leaves were deciduous, the rest were some deciduous, others partly or completely evergreen ; one or possibly two factors were apparently involved.

Fruit shape was also apparently dependent on two factors, the F_1 shewed heterosis in fruit size but the F_2 fruits were all below normal size. The size of cupule appears to be governed by two factors, which also appear to influence the thickness of the cupule scales. The flaking of the bark is apparently influenced by a single factor.

In spite of a certain sterility in the F_2 the results are such as to suggest that desired combinations of characters from the two species could be obtained by using large populations.

266. 634.972.2:576.356.5
MEURMAN, O. 634.972.2:576.354.46
Chromosome morphology, somatic doubling and secondary association in *Acer platanoides* L.
Hereditas 1933 : **18** : 145–73.

Five different types of chromosomes were distinguished by their form and size in the diploid (2n = 26) individuals.

Tetraploid cells occurred very frequently in the roots of diploid individuals and in these the double number of all the chromosome types was detected. The average proportion of these tetraploid cells was in the neighbourhood of 35 per cent, rising in some cases to 50 per cent ; the proportion was much higher at the base than at the tip of the root and so the tetraploid cells are more or less confined to the periblem, although odd ones were observed also in the plerome. A very similar state of things was also observed in *Cannabis* roots. This fact is connected with the mode of origin of the tetraploid cells, which seem to arise from cells in which failure of cell

wall formation has led to the presence of 2 nuclei, which apparently occurs only in the dermatogen. This also accounts for the lack of any definite zonation of the tetraploid cells.
Amongst the seedlings examined a triploid (39 chromosomes) was discovered and in this again cells with the double (hexaploid) chromosome number 78 were observed in the root. It is apparently not infrequent therefore for doubling also to take place in the sex cells, with the formation of diploid gametes.
The various chromosome types could also be distinguished at meiosis, where pairing in the diploid was absolutely regular. The 2 largest bivalents, made up, moreover, of chromosomes morphologically indistinguishable from one another, invariably lay in close proximity and often almost touched and the same association was detectable at metaphase II. No true quadrivalent formation was ever observed however and this is an undoubted case of secondary pairing. The basic chromosome number of the genus is therefore probably 12, or even some lower number. No evidence of the formation of diploid gametes was detected in the material examined.

267. 634.972.3:575.1
WETTSTEIN-WESTERSHEIM, W. v. 634.975:575.1
Züchtungsversuche mit Forstpflanzen. (**Breeding experiments with forest plants**).
Forstarchiv 1933 : **9** : 127–29.
As a preliminary to extensive experiments on the hybridization of poplars it had been shewn that cut twigs placed in water and allowed to flower could be successfully used as material for crossing, and also that even hybrids from species differing considerably in time of flowering could be obtained. By this method a large number of *Populus tremula* seedlings reared for the purpose were crossed with several varieties. So far the most vigorous and rapidly growing progeny have been obtained from *P. alba* x *tremula*, *P. alba* x *canadensis*, *P. eucalyptus* x *canadensis* and *P. alba* x *pyramidalis*.
Different results were obtained from certain reciprocal crosses *P. tremula* x *alba* in which the progeny proved less vigorous than when *P. alba* is used as the ♀ parent.
The properties of the hybrids as regards vegetative propagation are to be tested.
Since 1930 work on conifers has also been in progress with 80 progenies of selected individual trees, plants from approved seed being used for comparison. In the course of these experiments a strain immune to leaf cast was discovered, but unfortunately the mother tree of the strain had been felled and further breeding was therefore impossible. Since 1932, however, attempts have been made to select in a very broad fashion for immunity to this disease from among the progeny of artificially infected individuals ; but the expenses of collecting seed, etc. may prove prohibitive in the future.

268. STOUT, A. B. and SCHREINER, E. J. 634.972.3:575.12
Results of a project in hybridizing poplars.
J. Hered. 1933 : **24** : 217–29.
To procure better material for use in reforestation particularly for the production of pulpwood, a large number of crosses between different varieties of poplar were made during 1925–27.
Their progeny were selected on the basis of vigour of growth, ability to root from cuttings, hardiness, resistance to disease and shape of tree and its habit of branching.
The parents of the 69 hybrid seedlings finally selected were black poplars, cottonwood and balsam poplars. The hybrids proved definitely superior to their parents in the qualities desired.

269. GEORGE, L. 634.973:575.12
Observations sur *Sorbus aria*, *Sorbus terminalis* et leur hybride. (**Observations on *Sorbus aria*, *Sorbus terminalis* and their hybrid.**)
C. R. Ass. Franç. Av. Sci. 1931 : **55** : 234–35.
The hybrid is vegetatively very vigorous but sterile. Descriptions are given of the two species and of the hybrid, which differs from the parental species only in the number of vascular bundles in the petiole.

270. JONES, H. A. 635:575
Vegetable breeding at the University of California.
Proc. Amer. Soc. Hort. Sci. 1932 : **29** : 572–81.

Onions.
Inbreeding to purify the variety Australian Brown resulted in loss of vigour which was only regained by allowing cross-pollination between a number of pure lines. Italian varieties on the other hand shewed no such loss in vigour.
Controlled pollination is effected by means of flies which can also be used to cross-pollinate varieties.
Increased resistance to pinkroot (*Phoma terrestris* Hansen) has been secured by selection. A species cross has also been made between the almost immune *Allium fistulosum* which is also immune to smut, and the Yellow Globe Danvers variety of *A. cepa*. The F_1 was completely sterile but is being propagated vegetatively. Varieties from India said to be resistant to downy mildew (*Peronospora schleideni*) are being tested.
Resistance to thrips has been shewn by the White Persian onion, due to the growth habit of the leaves, and crosses have been made with varieties of commercial importance. Data on the nature of the inheritance should be available next year.
Selection for non-bolting lines has been entirely successful.
Garlic.
Tests are being made for resistance to the stem nematode but until it is found possible to induce flowering under Californian conditions, progress is difficult.
Cantaloupe melons.
Resistance to powdery mildew (*Erysiphe cichoracearum*) has been secured by crosses with immune varieties from India. The data indicate that resistance behaves as a simple dominant.
Progress is also being made in breeding resistant strains of other types of melons and cucumbers.
Celery.
The type of pithiness which is present from the seedling stage behaves as a simple dominant and can be controlled by eliminating the mother plants possessing the character. Selection has produced strains which are 100 per cent non-bolting.
Carrots.
Flies have proved successful pollinating agents for isolated plants. Experiments on inbreeding shew that there is marked loss of vigour after one year's inbreeding. It is possible from the work that is being done that root colour may be a genetical problem.
Tomato.
For the best results in tomato growing it is necessary to find the varieties best suited to the particular district and extensive tests are necessary. Breeding for resistance to curly-top has not yet achieved the desired result, though some of the dwarf types are slightly resistant.
Cauliflower and Broccoli.
Pollination in the bud stage has been found to give successful results with otherwise self-incompatible lines. Large amounts of seed can be obtained by inter-planting self-incompatible lines and this method enables the breeder to keep the parent stocks in his own possession.
Watermelons.
Inbreeding in the Klondike varieties has produced strains for all requirements and without loss of vigour. Crossing has produced lines of high quality which are 70 per cent resistant to wilt (*Fusarium niveum*).
Asparagus.
Breeding is in progress for general improvement and to produce a strain with small leaf scales, tightly pressed against the spear, suitable for canning purposes.
Flower Crops.
Flower seed production is one of the important industries of California and provides almost unlimited scope for the plant breeder in the creation of improved or resistant strains.

271. DETJEN, L. R. and MCCUE, C. A. 635.34:575.11
Cabbage characters and their heredity.
Bull. Del. Agric. Expt. Sta. 1933 : No. 180 : Pp. 149.
A full account of breeding experiments begun in 1912 with the Volga variety with records from 1916–1931.
Heading was investigated and the reappearance of heading plants in progenies from non-heading plants, especially as headlessness was not dominant, indicated the reassembling of a factor complex. Also it is believed either that the headless varieties used were not of the genotype $N_1N_1N_2N_2$ or else that headlessness in the commonly headed varieties differs from that found in other *Brassica* species.
The early character which initiates flower stalk formation any time before the ordinary rest period is determined by a multiple factor for season, and as this was also so for the character heading many-season strains can be evolved for both these characters.
Head form is also probably a multiple factor effect. Of the two characters clean and winged petioles the former was probably due to a recessive factor.
From observations on inflorescences 4 types were established, normal, late cauliflower, early cauliflower and bud, the first 3 being interrelated, the latter being a distinct type. The form of the flower stalk is thought to be conditioned by a multiple factor or set of factors. Incompatibility too has a similar genetic basis. Non-genetic incompatibility and the influence of temperature are also discussed.
Though no definite conclusions could be drawn about the inheritance in the peculiar headless strain termed Dwarf Saucer Rosette the various crosses made suggest that more than one factor is involved and that a linked lethal is probably operating too.
Fasciation of the head core, seedling colour, pod length and form, wavy leaf margin, leaf proliferation and savoy leaf were all found to be hereditary and most of these characters are probably due to multiple factor action. Phylotaxy, and various physiological and structural anomalies are mentioned ; and the problem of quality has been approached by a determination of the chemical composition of different strains, though no genetic analysis of quality was made. In conclusion the variability observed is considered in regard to the problem of the apparently close relationship existing between the various cultivated varieties of *B. oleracea* L.
Numerous plates and a bibliography of 58 references are appended.

272. WALKER, J. C. 635.34–2.484–1.521.6:575
Yellows-resistant lines of Jersey Wakefield cabbage.
J. Agric. Res. 1933 : 46 : 639–48.
The objects of this investigation were (1) to confirm previous findings regarding the homozygous condition for resistance to *Fusarium conglutinans* Wr., and (2) to ascertain whether resistance could be combined with the essential characteristics of the Jersey Wakefield variety. For the present paper only two classes were recognized : resistant and susceptible. Self-pollination and sib crosses of a commercial variety of Jersey Wakefield were used and an effort was made to maintain or improve the type though no characters except resistance were specially studied.
Two of the progenies obtained by selfing and two from the sib crosses proved superior in uniformity of earliness and in other desirable characters. Since they shewed no loss of vigour and were all homozygous for resistance they alone were used for further selection and in the F_3 cross-pollination of these was allowed to occur. The resultant plants proved as completely resistant as the progenies from which they were derived, i.e. resistance had been completely fixed in these lines. A comparison of these resistant strains with commercial Jersey Wakefield shewed that by rigid selection earliness and varietal type may be combined with resistance.

273. BLANK, L. M. and WALKER, J. C. 635.348–2.484–1.521.6:575
635.36–2.484–1.521.6:575
Inheritance of *Fusarium* resistance in Brussels sprouts and kohlrabi.
J. Agric. Res. 1933 : 46 : 1015–22.
Brussels sprouts plants which had remained healthy in a diseased field in 1928 were retained and subjected to self-pollination. Of the three plants so tested, one bred true to resistance, the

other two segregated into three resistant : one susceptible. The homozygous resistant plant crossed with a susceptible cabbage gave a resistant F_1, and one of the heterozygotes an F_1 segregating in the ratio 1 : 1. The F_2 families from these heterozygous F_1's also segregated into approximately 3 : 1.

Four plants of kohlrabi selected on similar lines gave three pure resistant families and one segregating, and the behaviour of the heterozygous and homozygous plants was similar to the corresponding types in Brussels sprouts.

The selection of surviving individuals thus affords a means of procuring resistant lines. It is thought probable that the resistance factor in these two subspecies is the same as the one already found in the cabbage.

274. PEARSON, O. H. 635.356:581.162.5
Incompatibility in broccoli and the production of seed under cages.
Proc. Amer. Soc. Hort. Sci. 1932 : **29** : 468–71.

A breeding programme for producing hybrid seed by crossing two pure lines of broccoli, each line being intra-incompatible but the two lines being inter-compatible was recently devised ; and on the basis of these results a successful method for obtaining small qualities of hybrid seed for experimental purposes by using honey bees to pollinate plants protected from foreign pollen by cheese cloth cages has now been evolved.

Full details of the technique and results are given.

275. 635.52–2.411.4:576.16
JAGGER, I. C. and CHANDLER, N. 635.52–2.411.4–1.521.6:575
Physiologic forms of *Bremia lactucae* on lettuce.
Phytopathology 1933 : **23** : 18–19. (Abst.)

In breeding lettuce for resistance to mildew (*Bremia lactucae*), several apparently distinct physiological forms of the fungus have been detected. In 1922 nine lettuce varieties shewed a high degree of resistance in trials in Florida and the same varieties behaved similarly in succeeding years at Chula Vista, California. In 1926 only two of these varieties shewed marked resistance in England to the apparently distinct form of the mildew occurring there. In 1927 three varieties proved highly resistant to a third physiological form then prevalent in Imperial Valley, California. The French variety Romaine blonde lente à monter has hitherto shewn considerable resistance to all forms of *B. lactucae* encountered. Crosses between this variety and New York or Iceberg have given several highly resistant strains at Chula Vista. In central California there seems to be a fourth form of mildew capable of attacking these hybrids, but from which the " Imperial D " strain is practically immune.

276. EMSWELLER, S. L. 635.53:581.45:575.11
An hereditary pithiness in celery.
Proc. Amer. Soc. Hort. Sci. 1932 : **29** : 480–85.

Two types of pithiness are distinguished, one in which only the outer petioles of the mature plant are affected and the other in which all the petioles are pithy (i.e. shew a breakdown of the central parenchyna) from a quite young stage. In a study of the second type, the author found that pithiness behaved as a simple dominant and that external conditions did not affect the pithiness or non-pithiness of the plants. The dominance of the character combined with cross-pollination would however account for its appearance in a field of celery.

277. WHITAKER, T. W. 635.61/3:576.312.35
Cytological and phylogenetic studies in the *Cucurbitaceae*.
Bot. Gaz. 1933 : **94** : 780–90.

When determining the chromosome numbers of several species and varieties of the *Cucurbitaceae*. it seemed of interest to test by controlled pollination the possibilities of intergeneric or inter-specific crosses in this family, and also the likelihood of species crossing under field conditions. The three species *Cucumis melo*, *C. sativus* and *C. anguria* all proved cross-sterile and were also sterile with *Citrullus vulgaris*. On the other hand *Citrullus vulgaris* and *C. colocynthis* hybridize

readily. It is stated that *Cucurbita maxima* and the reciprocal cross are successful but that the staminate flowers of the F_1 ultimately abort two or three days before anthesis ; the female flowers are normal though not numerous. The pollinations between *Cucurbita maxima* and *C. moschata* and also the combination *C. maxima* x *C. pepo* are briefly discussed.
Hence it would appear that species crossing is not common and under field conditions it would probably take place between *Cucurbita maxima* and *C. moschata* and between *Citrullus vulgaris* and *C. colocynthis*.
On the grounds of chromosome numbers, interfertility and a common habitat *Citrullus colocynthis* is generally regarded as the wild ancestor of the cultivated variety (*C. vulgaris*). The chromosome numbers of 12 species from pollen mother cell material are given. From the phylogenetical standpoint there are apparently three regions to which the *Cucurbitaceae* cultivated for food were originally confined : Tropical Africa and India and the highlands of Central America and South Mexico. The Old World species have basic numbers of 10, 11, 12 and 13 (except *Cucumis sativus* which has seven pairs of chromosomes), while the *Cucurbita* species of the north-west have 20–24 as the basic number. The non-cultivated members of this group coincide very closely with the cultivated members, the Old World genera having 10, 12 and 13 as basic numbers and the New World uncultivated *Cucurbita* having 20 and 16. As regards chromosome variability the *Cucurbitaceae* may apparently be grouped into (a) genera in which chromosome number of all recorded species is the same and in which morphological differences are apparently not related to chromosome number differences. (b) *Cucumis*, a genus where chromosome fragmentation may just possibly account for the origin of the 22 and 24 chromosome members of the genus from the 14 diploid chromosomes of *C. sativus*, and (c) *Cucurbita*, a genus exhibiting aneuploidy.

278. KANDA, T. 635.615:581.162.3:581.145.2
(Influence of the difference of the pollination mode on the fruits, seeds, and the next generation in a pure line of water-melon.)
Rep. Nara. Agric. Expt. Sta. 1932 : No. 1 : Pp. 19.
A five year comparison of the results of natural pollination, self-pollination, fertilization between two individuals from seeds contained in the same fruit and cross-pollination shewed :—
(1) Natural pollination resulted in the lowest fruit production (viz. 16·4 per cent as compared with 75 per cent in each of the other three modes of pollination), (2) The number of seeds per fruit is greatest with self-pollination.
There was no difference in the physical characters of seeds obtained by the 4 methods and the generations that follow self-pollination shew no inferiority as compared with their parents.

279. GABAJEW, S. 635.63
Systematische Untersuchungen an Gurkenarten und Varietäten. **(Systematic investigations on species and varieties of cucumber.)**
Angew. Bot. 1933 : **15** : 290–307.
Descriptions, with a key to the diagnosis, of the different types of cucumbers and their varieties, including a new species *Cucumis sphaerocarpus* which has been established for the " lemon " cucumbers, which are characterized by good flavour, high yield, extended period of bearing, and tolerance of hot climates, which qualities give it a special interest as breeding material.

280. CURRENCE, T. M. 635.64:575.061.1:575.116.1
Linkage relations of growth habit in tomato plants.
Proc. Amer. Soc. Hort. Sci. 1932 : **29** : 501–04.
The determinate habit of growth behaves as a simple mendelian recessive to indeterminate. Linkage was found between the factor for growth habit and leaf type with crossing-over of 2—4 per cent.
There was association between plants with the determinate growth habit and early ripening. Association between fruit size and growth habit was not definitely established.

281. LINDSTROM, E. W. 635.64:575.116.4
Linear order of four genes on the first chromosome of the tomato.
Proc. Iowa Acad. Sci. 1931 : **38** : 133–34.

The four first chromosome genes Dd, Pp., Oo and Ss were obtained in the recessive state in a synthetic individual, which was crossed with Marglobe, a quadruple dominant. The F_1 was backcrossed to the recessive and the data proved that the genes are in the order D—P—O—S. Single crossing-over occurred in all four positions but double crossing-over only between the P—O and O—S regions. One triple cross-over dPoS was obtained, but the plant was almost sterile, indicating some chromosomal disturbance. The difference in crossing-over frequency observed in male and female was not statistically significant:
A tentative chromosome map is suggested.

282. LINDSTROM, E. W. 635.64:575.243:539.16
Hereditary radium-induced variations in the tomato.
J. Hered. 1933 : **24** : 128, 129–37.

The experimental material used in this investigation consisted mainly of the first diploid generation derived from a haploid by doubling of the somatic chromosomes and was therefore absolutely homozygous. The technique is described in detail. Though a large number of functional and morphological abnormalities, either transitory or more or less stable, resulted from the treatment, only the following variations, which proved to be inherited and behave as single point mutations (though possibly due to inactivations or deletions, etc.), are discussed :—
1. Ridged (ri) or rough leaves, a recessive, transmitted independently of the d (dwarf) gene on the first chromosome, but giving indications of linkage with the c gene,
2. Virescent-white (v), a recessive which arose in the first generation in a fertile blue-green sector that had originated at the same time as a sterile light green sector after irradiation ; though slow growing the virescent whites set a few fruits with good seed development and the pollen was normal. This variant should be useful in linkage tests as it is most easily detected in the seedling stage.
3. Yellow foliage (l—lutescent) another recessive phenotypically resembling a less pronounced degree of the gene (ll) already known ; crosses with (l) from two different sources shewed the induced variation to be genetically identical with the author's original yellow (l).
4. Yellow seedlings (ys) a typical lethal recessive obtained from an intervarietal F_1 hybrid.
5. Rolled (rc) a recessive which appeared in the F_2 from the F_1 described under (4) above. The several effects produced by (rc) are, rolled cotyledons, slender growth, scarcity of foliage and slow development.
6. Sterile (st) a recessive causing sterility and affecting leaf colour and inhibiting growth.
The chromosome counts for vi, v, l, rc and st forms were normal (i.e. 2n = 24).
The virescent white mutation is regarded as promising material for a study of cytoplasmic changes and of the effects of radio-activity.

283. LINDSTROM, E. W. 635.64:576.356.5
Fertility variations in tetraploid tomatoes with different genetic origins.
Proc. Iowa Acad. Sci. 1931 : **38** : 85–87.

Diploids produced by Jorgenson's method from the sterile haploid (12 chromosomes) were completely fertile and tetraploids obtained from them by the same method shewed normal meiosis, although almost all 48 chromosomes formed tetravalents. About 20 per cent abortive pollen was observed, however, and the plants were less than 10 per cent fertile with their own pollen, and entirely sterile with pollen from diploid varieties. The plants obtained by self-pollination were some diploids, some tetraploids, and displayed varying degrees of sterility. The increased sterility of the tetraploids may be partly due to incompatibility between diploid and haploid pollen tubes and the tetraploid sporophyte tissue.
Tetraploids obtained from F_1's of varietal crosses produced fruits of normal size and in large quantities. They were fairly fertile, producing 40 per cent of the number of fertile seeds characteristic of the diploids ; some seeds were large (apparently tetraploid), others small (probably diploid) and many aborted seeds were also observed. These tetraploid plants also were sterile with pollen from diploids.

Tetraploids from *Lycopersicum pimpinellifolium* displayed a marked increase in vegetative vigour and size, and developed abundant fruit of nearly normal size and seed content on selfing. The plants of the progeny were remarkably uniform and all tetraploid. The cause for this true breeding of an autotetraploid is still unknown. It is pointed out that *L. pimpinellifolium* invariably shews a certain degree of sterility in crosses with *L. esculentum*.

284. SENGBUSCH, R. v. and WEISSFLOG, J. 635.64:581.192.2:575
Die Züchtung von wohlschmeckenden Tomaten. Die züchterische Bedeutung des Zucker– und Säuregehaltes. (**Breeding tomatoes of good flavour. The importance of sugar and acid content for breeding**).
Züchter 1933 : **5** : 169–73.

In connexion with the difficulties of finding a simple means of measuring the content of the elements of most importance from the point of view of flavour, the different sweetening power of the different sugars is mentioned, and the still greater difficulty of estimating the desirable and undesirable aromatic compounds.

As a preliminary measure therefore the tests have been confined to the total sugar and acid content, the former being estimated refractometrically, the latter by titration. Care is taken that the fruits have developed under similar conditions and are at the same stage of ripeness, etc. Tests were made on 38 cultivated tomato varieties and 6 wild forms of *Solanum lycopersicum* and *S. racemigerum*. The average sugar content of the cultivated varieties in 1931 was 4·9 per cent, in 1922 5 per cent, some varieties contained as much as 6·6 per cent. Wild forms were very rich in sugar, one from Ocumare la Costa contained as much as 7—8 per cent and *S. racemigerum* 7·3—7·4.

The average acid content in 1932 was 1·28. The lowest occurred in the cultivated varieties, some of the wild forms being the highest.

Observations were made also on F_1—F_3 families of cultivated varieties crossed with *S. racemigerum*. The sugar content of the F_1 was very little higher than the lower parent, but F_3 families with 8·3 per cent sugar, i.e. identical with *S. racemigerum*, appeared and odd plants gave as much as 9·6 per cent, with a fruit size twice that of *S. racemigerum*. The acid content of the F_2 was above that of the parents.

No appreciable correlation between fruit size and sugar or acid content existed, though to combine high sugar content with large fruit very large F_2 populations are required. A low but definite correlation which was evident between sugar and acid content will be favourable to the breeder.

The tomatoes with the highest sugar content were equal to an average apple and are worthy of consideration as a dessert fruit.

285. YASUDA, S. 635.646:575.127.5:581.145.2
(**On the behaviour of pollen tubes in the production of seedless fruits caused by interspecific pollination.**)
Jap. J. Genet. 1933 : **8** : 239–44.

The ovaries of egg plants produced seedless fruits on pollination by *Petunia violacea* but not by tomato pollen, the difference apparently being due to the relatively faster growth of the *Petunia* pollen tubes. On the other hand the pollen tubes of *Petunia violacea* grow more slowly in *Solanum Gilo* than in the egg plant and thus fail to stimulate the pistils to fruit formation. Squashes also shewed the same differential response when tested with pollen from *Calystegia japonica* and from the common sunflower, the failure of the latter as a stimulus being apparently due to defective germination.

The results obtained with *Petunia* pollen were confirmed by germination percentage tests in media containing the stylar juice of (1) the egg plant and (2) *S. Gilo*, and also by tests of *Petunia* pollen tube growth in pistils of *S. Gilo* grafted on (1) ovaries of egg plants and (2) their own ovaries. It would seem that depth of penetration of the pollen tubes determines the chances of development of seedless fruits and that inhibited pollen tube growth in the style results in no fruit formation.

The author inclines to think that pollen tube growth is influenced by some special substances which in the case of the egg plant and *S. Gilo* are possibly produced originally in the ovary and then mount to the upper part of the pistil.

286. McGinty, R. A. and Barnes, W. C. 635.648
Observations on flower bud and pod development in okra.
Proc. Amer. Soc. Hort. Sci. 1932 : **29** : 509–13.
Some preliminary morphological and physiological data on the okra plant the genetic behaviour of which is to be investigated later. The occurrence of intercarpellary fruits—a phenomenon previously attributed by Bergman to hybridization—is discussed.
Strains of okra almost free from the objectionable spines so commonly found are being developed.

287. Tschermak-Seysenegg, E. 635.65:575.127.2:581.466
Petaloide Ausbildung der Kelchblätter und andere Beobachtungen bei Bastarden zwischen *Phaseolus vulgaris* x *Ph. multiflorus*. **(Petaloid formation of the sepals and other observations on hybrids between *Phaseolus vulgaris* x *P. multiflorus*).**
Gartenbauwiss. 1933 : **7** : 407–10.
The hybrid plants resembled *P. multiflorus* except that they were low growing and lacked the twining habit of growth. Although backcrosses with *P. vulgaris* were successful the reciprocal *P. multiflorus* ♀ x *P. vulgarus* ♂ always failed. In two plants grown in the greenhouse during the winter and artificially illuminated during the night the sepals shewed a transformation into forms resembling petals. In one individual the stigma of all the flowers protruded beyond the keel in the bud stage so making self-fertilization impossible.
Also the plants grown under artificial light during the winter grew tall and twined, though when cut back and planted in the open in March they remained low-growing.
The abnormalities described are assumed to be due to hybridization possibly brought to light by the artificial conditions. The calycanthemy represents the first case recorded for the *Leguminoseae* and also the first outside the *Sympetaleae*.

288. Sirks, M. J. 635.651:575.113.7
Bemerkungen zu dem Aufsatze von C. Stern, "Zur Deutung eines letalen Effekts in Kreuzungen zwischen *Vicia Faba major* und *Vicia Faba minor* (nach Versuchen von M. J. Sirks)." **[Remarks on C. Stern's paper "The interpretation of a lethal effect between *Vicia Faba major* and *Vicia Faba minor* (based on experiments of M. J. Sirks)."]**
Addenda to Z. indukt. Abstamm.–u. VererbLehre. 1933 : **65** : (1).
A short note on Dr. Stern's comments on Dr. Sirks' tentative assumption of a diffuse lethal factor (see "Plant Breeding Abstracts," Vol. III, Abst. 752.)

289. Konold, O. 635.651:581.143.036:575.42
Der Vergleich des Pflanzenzuwachses mit dem Temperaturverlauf—ein Hilfsmittel für die züchterische Auslese. **(The correlation of plant growth and variations in temperature, an aid to selection in breeding.)**
Pflanzenbau 1933 : **9** : 430–36.
The relation between growth rhythm and temperature in *Vicia sativa*, *Lathyris sativus*, *L. clymenum*, *L. ochrus* and *L. tingitanus* was determined by daily estimations of length and of the temperature of air and of soil with other vegetation and of soil without. Only the growth period before flowering was considered as no relationship appeared to exist at the later stage.
As regards air temperature, no correlation with growth was found in *L. sativus* or *L. clymenum*, while *L. tingitanus* shewed a weak negative correlation and *L. ochrus* and *V. sativa* a weak positive correlation, and practically the same relationships were observed in the investigations in soil with other vegetation. In the soil of ground, bare except for the test crop, a weak positive correlation was exhibited by *L. sativus*, while *L. clymenum* shewed a correlation only at 30 cm. depth, *L. tingitanus* shewed no relationship, though *L. ochrus* did as before, and *V. sativa* gave a weak positive result. Evidently therefore the species differed in their response. On comparing these results, however, with the absolute lengths attained it appeared that the very species which gave a negative result exhibited the most rapid growth before flowering—a fact which might

perhaps be utilized in selection. By choosing individuals which, owing to their genetic constitution, shew rapid early growth independently of environment, various incidental injurious effects might be avoided.
The method though cumbrous might be used to estimate the growth rhythm of new varieties.

290. CAGUICLA, P. M. 635.652:575.42
Selection of varieties and strains of mungo (*Phaseolus aureus* Roxb.).
Philipp. Agric. 1933 : 22 : 23–42.
This is a study of local varieties of mungo. The samples, collected from various sources, were sorted into ' strains ' on the basis of seed colour. There are three main colours, yellow, green and black but, of the two former, there is a considerable range of which the most distinctive in each group is a dull and a shiny form. The various strains were found to be impure with regard to these seed colour differences but no genetical analysis by means of single plant cultures was attempted. A change of seed colour in storage is noted. Observations on germination, hairiness and form of leaf, colour of base of stem and node and the duration of flowering and maturity were made on the crop both in the wet and dry season. In addition, a number of analyses of ash, nitrogen and phosphorus are recorded.

291. STAPP, C. 635.652–2.3–1.521.6:578.08
Verfahren zur Prüfung von Bohnen (*Phaseolus vulgaris*) auf Resistenz gegen *Pseudomonas medicaginis* var. *phaseolica* Burkh. den Erreger der Fettflecken–krankheit. [**A method for testing beans (*P. vulgaris* for resistance to *Pseudomonas medicaginis* v. *phaseolica* Burkh., the pathogen of halo-spot.**]
Angew. Bot. 1933 : 15 : 241–52.
A method of testing resistance is described, as a preliminary to breeding for resistance. The variety Sachsa Stringless, formerly said to be resistant, proved susceptible by this method.

BOOK REVIEWS.

CLARK, V. A. 575
On seed selection and nutrition modifications. A botanical speculation.
Privately printed for the author. 1933 : Pp. 113.
By grading seeds of any plant according to specific gravity a distribution about a mode is obtained. The author's examinations of the seeds falling into the different classes lead him to conclude that those in the modal class produce plants superior in all respects. Such seeds are the only ones which breed true to type, this they do invariably. Deviations from this mode are ascribed to nutritional and hence metabolic abnormalities and are said to account for the segregation of hybrids, mutants, chromosome morphology and behaviour, etc. On this basis the assumption of factors, genes, or the like is said to be superfluous. Acquired characters are inherited by the alteration of the metabolism which they cause. The characters of the better nourished form are impressed on the offspring, thus accounting for dominance.
The reviewer can do no better than to quote the final paragraph of the chapter on inheritance :—
" These speculations on Mendelism are confused and unconvincing. Examination of material is necessary."

GOLDSCHMIDT, R. 575.1
Die Lehre von der Vererbung. (**The doctrine of inheritance.**)
Julius Springer, Berlin 1933 : 3. Auflage. RM. 4.80. Pp. vi + 216. 50 illus.
The third edition of Professor Goldschmidt's little work on popular Mendelism. On account of the circle of readers for which the volume is designed, a considerable proportion of the space is taken up in a discussion of such questions as the difference between hereditary and non-hereditary differences, in the course of which many illusions as to the inheritance of acquired

characters are successfully dispelled. The phenomena of fertilization, reduction and segregation are then described, followed by other general phenomena such as the influence of sex, linkage and crossing-over, the interaction of factors, polymery and mutation. The work ends with a short chapter on the bearing of the laws of heredity on sociological problems.

ILTIS, H. 575.1
Life of Mendel. [Translated by Eden and Cedar Paul.]
George Allen and Unwin, Ltd., London, 1932 : 12*s.* 6*d.* Pp. 336. 12 illus.
The whole realm of history can hardly contain a more fascinating story than that of the humble Augustinian monk, who by his patient experiments and observations in plant hybridization laid the germ which, after three decades of oblivion and neglect, was to bear the threefold fruit of genetics, cytology and plant breeding, three of the mightiest branches of modern biology. Having failed to attain recognition in his own lifetime, details about his life are not easy to find, but what little is known was collected and put before the German-speaking world in 1924 by Hugo Iltis, under the title " Gregor Johann Mendel, Leben, Werk und Wirkung." Only with the appearance of the present translation has the story become accessible to the English reader. The book is not only an account of Mendel's life and hobbies, with interesting and often amusing anecdotes and extracts from letters ; it also gives an outline of the position of the study of heredity at the time and of the influences which led up to Mendel's discovery, which accounted for its neglect by contemporary biologists and which finally led to its simultaneous rediscovery by de Vries, Correns and Tschermak.
The translation is free and attractive.
The book contains a number of portraits and is admirably indexed.

STOMPS, T. J. 575.24
Erfelijkheid en mutatie. (**Heredity and mutation.**)
W. Versluys, Amsterdam, Batavia, Paramaribo, 1933 : Pp. 40.
Various interesting historical facts are recalled, e.g. that the mutation hypothesis of de Vries was formulated in his work " Intracellulare Pangenesis " of 1889, Darwin having coined the work " pangene," later abbreviated by Johannsen to " gene " ; that these were regarded as probably of the size of the smallest existing organisms ; that de Vries in this work distinguished two classes of mutations, one involving a change in an existing gene, the other the formation of a new gene. An outline is given of the work of de Vries, with indications of some of the more recently discovered cytological phenomena by which the results have been re-interpreted.
Reference is next made to Baur's experiments but the opinion expressed that " multiple unilocal factors " are extremely rare and probably occur only in polyploids. Baur's results are compared with those in the fungi, where different degrees of sexuality exist in different geographical races and mutations of these degrees are not unknown.
A brief account of the *Datura* mutants is followed by a discussion of the *Drosophila* work of Morgan and his school and of the problem of mutations. In the latter connexion the author points to the intensity of ultraviolet radiation, which is now known to be capable of inducing mutation, in the mountain regions indicated by Vavilov as the centres of origin of cultivated plants. The direction of mutation is apparently controlled sometimes by external conditions such as temperature and this may in certain cases have accounted for the phenomena of orthogenesis.

GESSNER, F. 576.12
Die Krisis im Darwinismus. (**The crisis in Darwinism.**)
Gebrüder Stiepel Gesellschaft m.b.H., Leipzig, Reichenberg (Böhmen), Wien, 1930 : Pp. 40 ; also appeared in Freie Welt Nos. 235–238.
A semi-popular survey of the present position of the theory of evolution. After his introductory remarks the author outlines the Darwinian theory, then proceeds to the light shed on the process of evolution, Lamarckism, the inheritance of acquired characters, etc., by experimental genetics.

BREZLAVETS, L. P. 576.3
(Introduction to cytology.)
Published by " Sel'kolkhozgiz " Moscow 1932 : 2nd ed. 4 roubles. Pp. 296. 152 illus.

A manual for students, giving an introductory outline of the constitution of the cell and the nucleus, of cell division and fertilization ; their bearing on a number of hereditary phenomena is discussed somewhat fully. Nuclear behaviour in polyploids is described, and related phenomena such as apomixis receive attention. A chapter is devoted to the cytological investigation of the main agricultural plants, in which indications are given of the important role these studies have played in questions such as classification, interspecific and intergeneric crossing, mutation and the study of origin.

The printing and illustrations are not all that a western publisher would call desirable but the latter are well-chosen.

ZANDER, R. 58(014)
Handwörterbuch der Pflanzennamen und ihre Erklärungen. **(Pocket dictionary of plant names and their meanings.)**
Gärtnerische Verlagsgesellschaft, Berlin, 1932 : II. Auflage. R M. 6. Pp. 468.

This is the second edition of this compact little volume (first published in 1927) compiled by the Reichsverband des deutschen Gartenbaues with the collaboration of experts in Europe and America. Its object was to introduce uniformity into the botanical terminology used by the practical and technical horticulturalist in Germany by putting an end to the arbitrary naming of plants and by abolishing false and misleading synonyms, mis-spellings and faulty pronunciations and finally by bringing current usage into conformity with recent discoveries in systematic botany—all of which would put an end to the existing confusion and hindrances in commercial dealings.

The book is based on numerous standard works and on the international and the Berlin rules of nomenclature. General rules for the naming of new plants, pronunciation and remarks on the significance and linguistic treatment of the names of genera, species, varieties, etc. are given. An outline of systematic classification is followed by a systematic survey of plant names. An alphabetical list of families and genera precedes the alphabetical dictionary of latin genera, comprising also accepted scientific German equivalents with useful morphological, ecological and other details. A short annotated list of botanists of note whose names occur in a cross index of German to latin plant names, and an index of latin species names with explanatory and etymological notes, and a list of addenda dated 1932 brings the volume to a close.

With its avowedly practical aim and the exceptional ingenuity in condensed presentation this work will be of special value to the German horticulturalist, and it should also prove useful to those in other countries with a working knowledge of the language or to institutes in which German botanical literature is frequently consulted.

LEACH, W. 581.5
Plant ecology. For the student of British vegetation.
Methuen and Co., Ltd., London, 1933. 3*s*. 6*d*. Pp. vii + 104. 6 illus.

A comparatively new science, plant ecology has in recent years become more and more interlinked with neighbouring sciences such as plant physiology and in particular with studies of heredity and evolution. Those to whom the ecological point of view is unfamiliar will find a convenient approach through this booklet, in which the general principles are laid out clearly and simply, after which the practical methods of study and the ecological features of the British vegetation are outlined.

ADAMOVIĆ, L. 581.9(45)
Die pflanzengeographische Stellung und Gliederung Italiens. **(The phytogeographical position and zonation of Italy.)**
Gustav Fischer, Jena 1933 : Bound RM. 24, unbound RM. 22. Pp. xii + 259.

The author starts with a description of the nature of the Mediterranean flora in general. It is shewn how this flora has come from the most diverse sources and contains the most widely

differing elements. A large section of the book is taken up with tables shewing the occurrence of the species representing the various sections of the Mediterranean flora in the different sections of the country and the characteristics of the flora of the different zones and their climate are described.

The volume terminates with a bibliography of 31 pages and 31 charts illustrating the distribution of different plant groups, including cultivated plants such as rice, olive and citrus fruits.

ROBBINS, W. W. and RAMALEY, F. 633/4

Plants useful to man.

P. Blakiston's Son and Co., Inc., Philadelphia, 1933 : $ 3.00 : Pp. vii + 428 : 241 illus.

The material of the present volume is largely taken from Robbins' earlier work " The Botany of Crop Plants " but has been supplemented and revised, although the old forms of many of the latin names are retained contrary to modern usage.

The book starts with a very brief indication of the origins of cultivated plants, including the early efforts of breeders. In the eyes of those versed in the study of the origin of crop plants the opening statement that " All plants were originally wild " will seem somewhat audacious.

After some remarks on classification and nomenclature the authors proceed to descriptions of the various plant groups, with useful illustrations of the various organs of the plants in question, charts shewing their main areas of cultivation and indications of their chief uses. Economic plants of both temperate and tropical regions are included in this survey, as well as the main ornamental plants, vegetables, fruits and nuts.

TIMOSHENKO, V. P. 633.11(47)

Agricultural Russia and the wheat problem.

Food Research Institute and the Committee on Russian Research of the Hoover War Library, Stanford University, California 1932 : Grain Econ. Ser. No. 1 : $4.00. Pp. xi + 571.

A survey of wheat production in the Soviet Union, including considerable information also on more general questions such as land tenure, the agrarian revolution, etc. A chapter is devoted to a description of the wheat varieties in cultivation. This chapter also contains a brief outline of the development of plant breeding since before the war and a description of the production and characters of some of the most outstanding wheat varieties resistant to cold, drought, diseases etc., and adapted to different parts of the Union.

WATT, J. M. and BREYER-BRANDWIJK, M. G. 633.88(68)

The medicinal and poisonous plants of southern Africa.

E. and S. Livingstone, Edinburgh 1932 : 25*s.* 0*d.* Pp. xx + 314. 32 illus.

The use of the innumerable native remedies which exist in South Africa is fast disappearing. Before this occurs it is a matter of urgency that the plants on which they are based should be subjected to thorough investigation, since they constitute material which is likely to be of extreme interest as a source of new medicinal compounds or for plant breeding. The authors of the present volume have done an inestimable service therefore, not only to the medical but to the botanical world, in presenting the results of their study in this admirably clear and concise form.

The volume consists of descriptions of the uses to which the different plants are put by the various peoples, the properties they are claimed to possess and indications of their active principles.

The plants are arranged according to the botanical families of Harms and the value of the work is much enhanced by the presence of indexes of the botanical, English, Afrikaans and native names and of the active principles. Many of the plants are excellently illustrated and a list of appropriate references is appended to each group.

NEW JOURNALS.

Sankhyā. The Indian Journal of Statistics.
Vol. 1, Part 1, June, 1933. (Art Press, Calcutta.)

This new addition to the ranks of statistical periodicals is produced under the auspices of the newly-formed Indian Statistical Institute, and is supplied free to members of the Institute, as well as being on sale to non-members. The editor is Professor P. C. Mahalanobis, of Presidency College, Calcutta, who is well known as a contributor to theoretical statistics, especially on the anthropometric side, and who also confers a benefit on agricultural science in India through his statistical notes, written in conjunction with colleagues, and published in the Indian Journal of Agricultural Science. The new Journal is cast somewhat after the fashion of the English *Biometrika*, except that it is not restricted to the study of biological problems. The papers published in this part deal with: Indian Prices during the Depression, Studies in Educational Tests, Galton's work on the Evidential Value of Finger Prints, Maternity Statistics from Mysore, Revision of Risley's Anthropometric Data relating to Tribes and Castes of Bengal, Indian Official Trade Returns, and Tables for the Application of L-tests. These give a good idea of the catholicity of the subject matter. To quote from the Editorial " we are convinced that statistics represents a fundamental method of analysis of data in the mass which is applicable to any science of observation, and we feel that it is desirable to emphasise this essential unity in the methodology of statistics." We may anticipate that agricultural workers will benefit considerably from the papers, theoretical and otherwise, to be published through the medium of this journal, and we wish it every success. The journal is attractively produced, with a large page, and with paper and printing of distinction.

Le Sélectionneur.

The Association Française des Sélectionneurs de Plantes has begun the publication of a new journal devoted to questions of plant breeding. The first volume appeared in 1932 and consisted of a single number, under the title " Le Sélectionneur Français," which was changed in 1933 to the more embracing " Le Sélectionneur." The object of the journal is to publish the official communications of the association, together with original articles on breeding plants of practical interest and to keep its readers informed of current French and foreign literature.

The first number contains, in addition to the Acts of the Association, a report of the Committee of the International Association of Plant Breeders, a note on plant patents, an article on comparative yield trials, and a note on the scheme for the maintenance of a catalogue of species and varieties of crop plants.

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